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DISTRIBUTION OF INDUSTRY IN BRITAIN

CRITICISM of the Distribution of Industry Bill of the Coalition Government of 1945 centred mainly on the two points: whether the Government had a central policy in regard to the location of industry, with all that such a policy implies in regard to the control of the use of land, town and country planning, agriculture, building and amenities; and whether the Board of Trade was, or would be, staffed with the type of Civil servant qualified by training, outlook and experience to deal with these positive functions of government with imagination, decision and courage. No central independent tribunal had then been established to consider the national position as a whole, as recommended in the report of the Barlow Commission, nor has the present Government taken such action.

The paper on "Distribution in Industry" just issued by the Board of Trade* once again indicates the seriousness of the omission. The immediate occasion for the paper is the duty placed by the Act on the Board of Trade jointly with the Secretary of State for Scotland of reviewing the boundaries of the Development Areas from the passing of the Act. The paper examines in some detail the results which have followed, partly from war-time developments, and partly from the operation of the policy adopted, not only in the Development Areas, as the old Special Areas have been designated, where they are most apparent, but also in the rest of Great Britain. On the negative side, the Government has restricted new industrial development in parts which were already congested with industry; and on the positive side, it has, with the co-operation of many industrialists, assisted the Development Areas and other parts which needed more industrial employment.

The situation in the Development Areas has changed for the better, both absolutely, and relatively to other parts of Britain. Employment in these areas is much greater than before the War, while unemployment is now much smaller; and when the programme of industrial growth at present only half completed is fulfilled, there should no longer be a special danger of heavy localized unemployment in most parts of the Areas. There will be more of the industries which have been less liable to depression than some of the basic industries in which the greatest proportion of workers in those Areas was previously engaged. The existence of a wider range of industries will also mean that a recession in any one of them will have less effect on the economy as a whole. Nevertheless, the White Paper argues that it is too soon to remove the whole or part of any of the present Development Areas from the first schedule of the Act. On the contrary, it recommends the addition of two new Areas: Merseyside, and a district to serve as an industrial nucleus for the Highlands of Scotland.

The policy on the distribution of industry pursued by the Board of Trade has as its purpose the pro-

* Distribution in Industry. (Cmd. 7540.) Pp. ii+52. (London: H.M. Stationery Office, 1948.) 1s. net.

vision of regular work for the greatest possible number of those seeking it in all parts of Great Britain, especially in those parts which are known as the Development Areas, and so helping to raise the number in work and the nation's total output to the highest possible level. Now, although the White Paper admits that sometimes there have been sound economic reasons why movement of particular enterprises to the Development Areas was impracticable, such a purpose, the natural development of the policy evolved in the late thirties, fails to take adequate account of the new situation. What were the 'depressed' industries are now those that most need labour. Furthermore, Britain's economic recovery depends on capital reconstruction and equipment being concentrated in those industries where it will increase exports or save imports.

These are the principles against which we must judge the fact that about half the new factory-building since the War has been in the Development Areas, which have only 2,500,000 of the country's workers. The weakness of the White Paper is that it fails to take account of, and clearly distinguish, the social and the economic aspects of the policy it describes. The White Paper, in fact, is exclusively concerned with the first—the prevention of widespread unemployment—and so much ignores the second that it does not stop to consider whether, measured by the numbers placed in employment, the experiment in directing new industries to the Areas has been very costly. Nor is there shown any awareness that the attraction of a particular enterprise to the Areas may increase the cost of its products. For example, it is probable that location of the British Nylon Spinners, Ltd., mill at Pontypool, instead of at Banbury, may, owing to the double haulage of the polymer and the spun yarn necessitated, involve in effect a small continuing levy on nylon sales.

Under pre-war conditions, it might still have been worth while, from the national point of view, to locate this industry in Monmouthshire. Under post-war conditions and with the present insistence on exports, where costs are becoming increasingly important, particular instances must be judged by the same criteria as the general policy: are resources being directed into the Development Areas which could from the national point of view be better employed elsewhere, and is the movement of labour from those Areas to other districts urgently needing men being prevented? We cannot continue to build factories for unimportant industries while industries where development is essential are unable to get new buildings and equipment. On these issues the White Paper is silent. Nor does it consider the social implications of the present policy of encouraging in those Areas the lighter industries providing consumers' goods. Quite apart from the question of which type of industry should be encouraged from the point of view of economic recovery, the demand for export goods is much more likely to be sustained than that for the consumer goods coming from the light industries.

The dominant impression left by this White Paper is, in fact, the lack of clear thinking. There is no evidence that policy is governed by explicit principles about the distribution of industry. The slightness of the reference to the report of the Barlow Commission indicates the absence of such a coherent policy, and it would not be unfair to conclude that the influence of pressure groups has deflected the Board from paying attention to the essential price that has to be paid for social security—mobility of labour. This is not a matter of directing men and women to the factories rather than, so far as possible, bringing the factories to the workers. Security and enterprise are uneasy bedfellows, but both are essential in any economic system; and enterprise is a quality not to be restricted to the management or employer. It is true that the State must now ensure that there are certain minimum social and economic standards below which no one can fall, in order to forestall the threats of insecurity to the efficiency of its industrial and economic life. It is equally true that, under modern conditions, the workers cannot enjoy the higher standards of living which mechanical advance has put within their reach unless they themselves show enterprise, initiative and adaptability to the changing conditions.

The most hopeful section of this White Paper is that which deals with research for the future. For all its shortcomings, it recognizes that wise conduct of the distribution of industry demands constant study and examination of the needs and resources of every part of Britain, and that the future of the Development Areas is bound up with that of world trade and our share in it, and with that of certain basic industries such as coal, steel and shipbuilding. Among the functions which the Barlow Commission recommended that a central authority should discharge was the organisation of research, and it was recognized that to provide a sure basis for action under the Development of Industry Act it was essential that the Government should establish a research organisation capable of studying the many problems of industrial location in greater detail than had hitherto been possible.

Regional research units have been set up jointly by the Board of Trade, the Ministry of Labour and the Ministry of Town and Country Planning, and, in Scotland, the Department of Health. This policy of decentralization has already borne much fruit; thus the plan for the West Midlands region recently produced by Sir Patrick Abercrombie and Mr. Herbert Jackson at the behest of Mr. Silkin is one example. Small research staffs, however, are maintained at headquarters to direct and co-ordinate the work in the regions, to provide basic data of a national character and to study particular problems which can be most effectively studied at the centre. An extensive programme of research has been undertaken to assist the regional offices of government departments concerned in the execution of the distribution of industry. General surveys of all the regions and sub-regions throughout the country have furnished knowledge about such matters as variations in the industrial structure of regions and sub-regions and their causes, difference in industrial specialization and diversification, divergences in the degree of vulnerability to structural and localized unemployment as

between areas, industrial facilities and basic services, the constitution and geographical distribution of industrial population, labour supplies, industrial sites, the availability of factory premises, housing and general amenities.

The administration of the Distribution of Industry Act has revealed some problems requiring special investigations of particular areas or towns, and the possible uses in peace-time of war-time government factories. It is also stated that the development of physical planning, the drive to increase production in the textile and other industries, and the necessity for concentration upon the manufacture of goods to meet the export target, have all led to further research; though, as already indicated, the White Paper does not elsewhere indicate much awareness on the part of the Board of Trade of this point where the Development Areas are concerned. In addition to the maintenance of comprehensive records of what has been done or is planned, the fullest measure of co-operation exists with the research officers of the Ministry of Town and Country Planning, as well as with the staffs of local planning authorities, to ensure that research on distribution of industry problems is properly related to all developments in town and country planning.

Most of the activities described in this section of the White Paper admittedly relate to current issues and short-term problems; and in this account more reference might well have been made to the contributions from other bodies such as the West Midland Group and the Northern Industrial Group. The study of long-term problems, however, has also been undertaken, and here it is recognized that there are certain fundamental problems which are best investigated by the universities. To ensure that these problems will receive attention, the Board of Trade set up early in 1947 an informal committee, with Sir Henry Clay as chairman, consisting of members of the economic and statistical departments of several universities, to consider how the assistance of the universities might be secured.

This account of the research activities of the Board of Trade in the field of the location of industry, set against the general trend of the whole report, conveys the main impression that failure to implement the proposals of the Barlow Commission has been due to ineffective co-ordination, duplication of effort and the absence of any authority competent to choose the right subjects of research and ensure that the results of research are used. Unified research into the problem of distribution on a national scale is embryonic; there is no unified plan of development based on such research, and no effective control meanwhile of such changes as must continue to take place in the interests of trade. We are no nearer than when the Distribution of Industry Act was passed to the effective relation of schemes for industrial development to those for hydro-electric development, water supply, the building of new towns and the like.

The absence of that high standard of ministerial statesmanship which Gertrude Williams, in her book, "The Price of Social Security", showed to be the essential foundation of successful government control of any communal activity effectively prevents the formulation of a national policy. Piecemeal developments and yielding to sectional interests make the objectives professed in this White Paper as farcical as the continued encroachment on national park areas or Nature reserves by unco-ordinated demands from the Services and other interests make the nominal profession of the Government of supporting the idea of Nature reserves or national parks. This White Paper shows little sign of the imagination, vigour and statesmanship which could reverse these trends, and give Great Britain a genuine national policy for land use in which the claims of defence, amenities, industry and culture are fairly balanced, apportioned and reconciled.

THE LIFE AND WORK OF CHARLES DARWIN

Charles Darwin

Par Jean Rostand. (Collection 'Leurs figures'.) Pp. 244+4 plates. (Paris: Libr. Gallimard, 1947.) 220 francs.

THIS book is easily readable. It deals in a pleasant manner with Darwin not only as a man of science but also as an individual. It mentions, but does not stress, the shocking state of health in which Darwin carried out all his work after he returned from the voyage with the *Beagle*. The fact that, during the years 1837–59, while Darwin was collecting together his material for the "Origin", he carried out and published all the geological results of the *Beagle* expedition and, at the same time, produced a monograph on the barnacles which is still the standard work on this group can only be appreciated when it is remembered that he could only work at his desk for relatively short periods and was continually bound to lie down and rest after these short periods of exertion.

The book, however, cannot be said to throw any new light on Darwin. It is written in the modern Neo-Mendelian idiom. One sentence (p. 144) gives away the author's attitude. He maintains that one of the greatest originalities of Darwin was to have seen in the variation of domestic animals the image of the phenomenon of evolution. To a Neo-Mendelian this may make sense, but, of course, it begs the question. Then, again, the author states definitely that we now know that acquired characters are not inherited. Whatever view one may take as to Lamarck's theory—a theory which, the author rightly points out, was always misunderstood by Darwin—it has certainly never been established scientifically and probably never will be that acquired characters *cannot* be inherited. Surely it is a fact that recently one of our leading Neo-Mendelians published an account of a mechanism based on the conception of the gene complex whereby acquired characters *could* be inherited. They cannot have it both ways!

It is a pity that the author does not stress the fact that in the title of the book "On the Origin of Species" there are two inaccuracies: the word 'origin' should really have been 'establishment' after the species had originated, and then the word 'species' is not defined; and Darwin pointed out in a letter to Hooker "to define a species is to wish to define the indefinable".

H. GRAHAM CANNON

COTTON SEED: A PIONEER CROP AND AN EXAMPLE

Cottonseed and Cottonseed Products

Their Chemistry and Chemical Technology. Edited by Alton E. Bailey. (Fats and Oils, a Series of Monographs on the Chemistry and Technology of Fats, Oils and related Substances.) Pp. xxiii+936. (New York and London: Interscience Publishers, Ltd., 1948.) £5 5s.

THE cultivation of cotton in quantity in the United States did not commence until towards the end of the eighteenth century; but the cotton fibres only were utilized for many years, the rest of the cotton seed not being recognized to have any, except perhaps manurial, value. Although so early as about 1830 crushing of the seed was commenced in a small way, it was not until after the American Civil War that the value of the cotton seed was more fully appreciated, and that its conversion into cotton-seed oil and cotton-seed cake was undertaken on an increasingly large scale. From 1910 onwards, however, cotton-seed crushing became one of the major industries in the United States. Frequently, the quantity of cotton seed crushed annually exceeded 5,000,000 tons, the corresponding value of the products (oil and residual cake) usually being more than 200,000,000 dollars. The annual production of cotton-seed oil was 700,000–900,000 tons, and of cotton-seed cake and meal 2,000,000–2,500,000 tons. The cake is valued as an animal feeding-stuff and is also used as a fertilizer, while the oil is used both as salad oil, in margarine and in cooking fats (lard substitute) either in its original state or after 'hardening' by partial hydrogenation, and as one of the raw materials for soap-making.

Thus a by-product of the production of the cotton plant for textile purposes came at length to be the source of a number of other materials of vital importance, notably the contribution of three-quarters of a million tons or more annually of valuable edible fatty oil. The cotton-seed crushing industry was thus a pointer to what is now seen to be an urgent need in overcoming the increasing world shortage of fats, namely, the cultivation of suitable species of oil-seeds primarily for the sake of their oil content and of their residual cake or meal for feeding animal stock. Moreover, the careful selection and cultivation of both seed and crop, which have been practised for many years in order to secure constancy of quality in the cotton fibre, are evidently an example to be followed in the cultivation of other oil-seeds in order that oil and cake of the highest quality may be produced. Oil-seed cultivation is a branch of agriculture with its own special problems demanding specific control in regard to the quality of the products ultimately to be harvested.

The present volume of more than 900 pages, edited by Dr. A. E. Bailey, is thus informative to the British reader not only for its wealth of information on cotton-seed products, but also for the utilization of the knowledge acquired in this industry when dealing with other oil-seeds. The book is remarkable for its scope and for the exhaustive manner in which the details of all phases of the industry have been covered. It consists of twenty-four monographs, each of which has been written by an author with special knowledge of the part of the subject which has been entrusted to him. It opens with two monographs which deal with the history of the cotton-seed industry and its economic development, and here, as elsewhere in the book, the discussion is not restricted to the United States, but also includes full accounts of the smaller but still important cotton industries of India, Egypt and some other countries. The next seven monographs (amounting to 400 pages) deal very fully with the constituents of cotton seed—fatty oil, proteins, pigments, etc.—and also with the influences exerted upon these by differences in variety, maturity and environment of the growing cotton plant, while a separate section is devoted to the biological processes of the cotton seed. Later sections cover equally exhaustively the processing of the seed and of its various products, naturally with special emphasis on the refining, hydrogenation, etc., of cotton-seed oil for use as an edible fat. There is also a useful discussion on the nutritional aspects of cotton-seed oil utilization in the human dietary (which, in fact, covers and includes the corresponding aspects of most other vegetable fatty oils); and the concluding monographs deal with cotton-seed oil for soap, cotton-seed cake as a source of animal food-stuffs, and the utilization of cotton-seed hulls and linters.

The book is outstandingly comprehensive in its exhaustive treatment of all the factors—scientific, technical and economical—connected with the cotton-seed industry. The enormous quantity of factual data of all kinds appears to have been collected with accuracy and is certainly presented lucidly and clearly. Full references to scientific and technical literature are given, with adequate author and subject indexes. The editor and publishers are to be congratulated on the production of so complete a guide to the products of the cotton seed, and to the technical aspects of the important industries which have been built up in connexion with its processing.

As indicated earlier, the volume is of importance and interest to a wider circle than those concerned with cotton seed itself. The principles involved in the cultivation and processing of cotton seed are in many instances equally applicable to other oil-seeds. Notably this applies to consideration of the variety and environment of the plant in relation to the seed fat produced, and to the influence of moisture and enzymes on retrogressive changes within the harvested seed, leading to oxidation and to production of free fatty acid in the seed fat. As we have seen, cotton-seed oil is by way of being a by-product; the same may be said of soya bean oil, now produced to about the same extent as cotton-seed oil in the United States owing to the demand of the American farmer for soya bean cake. In the British Empire and elsewhere, except for coconut plantations, deliberate cultivation of oil-bearing species only commenced with that of the oil palm about 1910. Systematic cultivation of seed crops primarily for their oil content is thus still a comparatively young development in agriculture. Groundnuts will soon be grown in large quantities, and sunflower and some few other oil-seed crops are being developed; intensive cultivation of other selected species capable of yielding fatty oils suitable for edible, soap or paint purposes must be set in hand in tropical or sub-tropical localities with as little delay as possible—perhaps sesame, soya bean and some additional oils for edible fats and soaps, safflower, candlenut or other oils of a more unsaturated type to correct and relieve the over-dependence on linseed oil of the paint and allied industries. The information already

available in the case of cotton seed will be of profound advantage to those responsible for developing these new fat resources.

Nevertheless, it is clear that for a long time to come an important proportion of our vegetable fat supplies must continue to be derived, as of yore, from seeds or nuts grown by the native peoples in Africa or elsewhere, or collected by them from the fruits of wild trees and shrubs. Thus, the oil palm plantations still yield only about one quarter at most of the total supplies of palm kernels, while groundnuts have hitherto been cultivated only in primitive fashion in India and in West Africa. Here it is of urgent importance to teach the native peoples and others concerned two simple but essential principles: oil-seeds must be gathered exactly at maturity; they must be thoroughly dried and kept dry until they reach the seed-crushing plants.

Dr. G. Scott Robertson, in his presidential address to the Agricultural Section of the British Association last September, commented upon the enormous loss of good grain by insect and mould infestation. Loss and deterioration of good edible fats in oil-seeds is undoubtedly at present proportionately far greater, owing to the retrogressive changes, especially in the fat, caused by damp conditions in storage and much accelerated by enzymes already present in the seed, as well as those introduced by mould infection. Oil from native West African groundnuts may contain 10 per cent or more of free fatty acid, in which case more than 30 per cent of the crude oil must be lost in producing a refined edible oil. Indian groundnuts usually give oil with not less than 3 per cent of free fatty acid. There is no reason why, if the principles developed in the cotton-seed industry and fully discussed in the volume reviewed in this notice are applied to groundnuts, the free acidity of crude groundnut oil should exceed 1 per cent, with corresponding improvement in its colour and general appearance. The world production of edible fats could be notably increased (by perhaps 10–15 per cent at least), without any increase in the tonnage of oil-seed crops, by insistence on these simple principles of hygiene in harvesting, storage and transport.

T. P. HILDITCH

CLASSIFICATION OF BACTERIA

Bergey's Manual of Determinative Bacteriology

By Robert S. Breed, E. G. D. Murray and A. Parker Hitchens. Sixth edition. Pp. xvi+1529. (London: Baillière, Tindall and Cox, 1948.) 82*s.* 6*d.*

TAXONOMY, "that branch of biology which treats of classification in accordance with a convention or law", is the neglected foster child of bacteriologists, most of whom call their pet *Bacillus this* or that-coccus, and for taxonomy care nothing at all. But however much classification may be neglected, nay, even be despised, it is not only the bookworm and the historian who pursue it as an armchair study; it is also a field where research is active, and there is increasing need that the newest ideas and techniques should be brought to bear on old problems of bacterial relationships. The modern approach collects strains into groups with stable characters and ignores minor differences that were once thought to be important; when the groups have proved their value in classification they are given generic and specific names. Groups worked out according to this principle include the genus *Salmonella* and species like *Streptococcus pyogenes* and *Str. agalactiæ*, all of which have a serological basis. Much of the older work has now lost its value and should be reconsidered in the light of modern findings. The need for this is seen in the section on micrococci in "Bergey's Manual"; only twenty-two species are recognized (scarcely one is well characterized), but there is an appendix of more than four hundred names of so-called micrococci. As Abd-El-Malek and Gibson said recently, "The genus *Micrococcus* provides what is probably the worst example in bacteriology of uncritical systematic work".

Most systems of classification try to show natural relationships; but what criteria—morphology, metabolic activities, pathogenicity, or antigenic structure—are required to show these is unknown. Different relationships are brought out according to the criterion of kinship used; similarity of metabolic products makes cousins of streptococci and lactobacilli, morphology makes streptococci brothers of staphylococci, a relationship supported by the sharing of common antigens. "Bergey's Manual" adopts a classification based mainly on two characters, morphology and metabolic activities (where these do not clash), uses pathogenicity (as in *Erwinia*) to a small extent, and antigenic relationships scarcely at all. Few will quarrel with the outline classification into families, but fewer in Great Britain will accept the further subdivision into genera and species. In spite of an increase in the number of genera, there are welcome signs of retraction; *Eberthella*, *Proactinomyces* and *Staphylococcus* have disappeared, and *Klebsiella* has probably appeared for the last time.

By its title "Bergey's Manual" sets itself an impossible task: to construct, from data at present available, a key by which any bacterium can be identified. If we admit that, though perfection cannot be aimed at, such a key is desirable, there are two approaches to the problem: to limit the scheme to well-characterized species, using only proved criteria in the construction of the key; or, the other choice, to include as many species as possible at the expense of having to use less stable criteria for species differentiation. In the "Manual" most writers adopt the second course; notable exceptions are the sections on *Bacillus* and *Mycobacterium*, the authors of which have shown a welcome ability to cast historic but ill-defined species into oblivion, or to show their true status as synonyms.

If all sections resembled Nathan R. Smith's treatment of the genus *Bacillus*, with descriptions based on studies by modern methods of authentic cultures, there would have been no need to repeat vague details of ill-defined species, many of which are no longer available for study. It may not be ethically correct, but it would be a sound practical move to abolish priority and afford recognition only to species the types of which are preserved in dried or other permanent form, the naming and placing of such species being supported by adequate descriptions of the organisms and comparative studies with related species and genera. The editors of the "Manual" have made a move in this direction; many species recognized in earlier editions and now mainly of historic interest are listed in appendixes.

Much effort would have been saved—and a better book produced—if writers of the different sections had recorded only species with which they were familiar from their own bench work.

S. T. COWAN

Electrolytic Polishing and Bright Plating of Metals

By Dr. S. Wernick. Pp. xv+243. (London: Alvin Redman, Ltd., 1948.) 30*s*. net.

IN the author's preface and in the foreword by Dr. U. R. Evans, great stress is laid on the commercial value of a brightly finished metal article, be it a piece of a machine or merely a luxury knick-knack. In the foreword it is further pointed out that there is a great practical utility in smoothness, and the examples of reflectors and bearings are quoted; but it is surprising that he does not mention the fact that electrolytic polishing seems to secure a measure of greater resistance to the normal tarnishing of metal surfaces. Except for a fairly full account of the anodic oxidation of aluminium, which is a rather exceptional case, the author's mention of corrosion is more or less limited to a couple of pages (146 and 147) in the chapter on carbon steel. Thus, when one considers the enormous sums of money that are annually expended in combating corrosion, it is surprising that (according to the author) for most metals the extent of the increased protection afforded by electrolytic polishing is rather uncertain.

It seems that to obtain a bright surface there are two rival processes, electrolytic polishing and the deposition of an inherently bright plate; and Dr. Wernick has written a very detailed account of the two techniques even to the extent of suggesting how the former may be used to reinforce the latter. The special attention devoted to nickel surfaces and the appendix on its bright plating are particularly interesting. Little or no theory is presented, as the exact mechanism of these processes does not appear to be understood; but this book is a wealth of empirical information. As such it will be of great value to the qualified chemical engineer and, being written simply and in a straightforward style, it can be recommended to manufacturers, works managers, etc., who may not have had any formal chemical training.

Dimple-Based Pottery from Central Kavirondo, Kenya Colony

By M. D. Leakey, the late W. E. Owen and L. S. B. Leakey. (Coryndon Memorial Museum Occasional Papers, No. 2.) Pp. 43. (Cambridge: Deighton, Bell and Co., 1948.) 5*s*. net.

STUDENTS of the later stages of African prehistory will welcome the publication of the detailed analytical study by Mrs. Mary Leakey of the iron-age pottery industry discovered by Archdeacon W. E. Owen in the Central Kavirondo of north-western Kenya. Isolated discoveries of pottery with little, if any, apparent affinity to known cultural groups are too frequently merely stored and their publication held over for further evidence. Since modern and recent domestic pottery in tropical Africa often appears to differ so slightly in the details of shape, ingredients and decoration, it is precisely the exceptional elements, like the occurrence of the impressed dimple in this Kavirondo material and its unusual decorative motifs, that are likely to be of significance to workers in other parts of Africa. The excellent drawings by Mrs. Leakey, supported by eight pages of photographs, and the descriptive analysis will give the reader a very accurate idea of the quality of this important pottery assemblage.

No definite age can be postulated for the dimple-based pottery until the geological significance of Owen's "Bed 5" horizon has been determined. The long-range correlation throughout the equatorial belt of the pluvial phenomena deposited during the last important climatic phase (the Nakuran wet phase of East Africa) presents difficult problems which may well eventually be solved by the type of evidence described in this paper. Recent discoveries in northern Nigeria of a pottery culture, associated with late neolithic and early iron-age material, in sealed deposits of a widespread and persistent type invite a very tentative equation with similar deposits (Nakuran) in East Africa, and emphasize the importance of the early publication of *in situ* cultural material throughout the continent.

BERNARD FAGG

Gall Midges of Economic Importance

By Dr. H. F. Barnes. Vol. 3: Gall Midges of Fruit. (Agricultural and Horticultural Series.) Pp. 184+9 plates. (London: Crosby Lockwood and Son, Ltd., 1948.) 15*s*. net.

DR. BARNES is a tireless investigator with an extensive output of original papers to his credit. He is, furthermore, a world authority on the Cecidomyidæ or gall midges and, therefore, the proper person to write a book of this kind. It forms the third of a projected series of volumes which he is to write on gall midges of economic importance. As planned, the series will run into eight volumes; the last volume is also to contain a general index to the whole series.

The present volume, like its two predecessors, provides entomologists with well-documented accounts of all that is known about certain kinds of gall midges—in this case those affecting fruit. Much of Dr. Barnes' own work is incorporated in its pages, and he surveys the subject in a thoroughly comprehensive manner, since all known gall midges affecting fruit in different parts of the world are included. A book of this kind, written in a terse but clear style, is invaluable to the horticulturist, the advisory officer and, in fact, to entomologists of all persuasions whether economic, biological or taxonomic in outlook. The long and complete literature list at the end of the book adds greatly to its value as an authoritative work and will mark it out as a standard source for future reference. The author is to be congratulated on his effort, and we wish him every success in completing the task before him.

A. D. I.

Practical Zoological Illustrations

Invertebrates. By W. S. Bullough. 32 cards, 14¼ in. × 9¾ in. (London: Macmillan and Co., Ltd., 1948.) 15*s*. net.

THESE cards, illustrating the structure of invertebrates, are on the same lines as the vertebrate series by Lockyer and Crofts. Selected types from the protozoa, cœlenterates, flatworms, roundworms, annelids, crustacea, insects and molluscs have been chosen, and a few figures of *Amphioxus* appended. The drawings are clear and bold, the directions concise, and the notes on the culture of some of the organisms should prove useful. But the set is more suited to the school than to the university, being neither accurate enough nor full enough for first-year university students, who would discover errors in many of the figures, for example, in the leg of the cockroach, the head of *Nereis* and the gills of *Amphioxus*, and who would need sections as well as dissections of their types.

The printing and production are excellent.

BLOOD CAPILLARY CIRCULATION UNDER NORMAL CONDITIONS AND IN TRAUMATIC SHOCK

By PROF. ROBERT CHAMBERS
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AN important feature of the peripheral circulation is the close correspondence between the local needs of a given tissue and the amount of blood supplying it. Controlling mechanisms, to accomplish this, must involve more than the vasoconstrictor and dilator reactions of the terminal arterioles. Krogh attempted to ascribe the relative autonomy of the capillary circulation to the widespread occurrence of contractile, pericapillary elements, the Rouget cells. This has been considerably debated, and has never been adequately demonstrated. Moreover, there is still the question concerning the manner in which an adequate venous return can be maintained in spite of the supposed interposition, between arterioles and venules, of a network of extremely pervious capillaries[1]. The techniques hitherto used for observing the capillary vessels have been either too fragmentary or have lacked the required delicacy of experimental approach for ascertaining their highly reactive and finely balanced behaviour.

An adequate survey of the capillary bed for a study of variations in its functional activity requires a tissue in which the vessels can be traced from the arteriolar to their venular ends and, at the same time, can be exposed for observation with a minimum of trauma as not to upset the normal reactivity of the functioning components of the bed.

Three important regions, in which physiological fluctuations in blood supply occur normally from time to time, are the skin, the skeletal muscles and the viscera. In the skin, the circulation is somewhat specialized because of its temperature-regulating mechanism, and is a fertile, though difficult, field for investigation. The skeletal muscular system offers good possibilities. Unfortunately, in mammals it has the disadvantage that the trauma required for exposing it for microscopic study is excessive. Thus far, the most satisfactory has been the visceral region, particularly the mesoappendix of the rat and the omentum of the dog. The incision in the body-wall to expose these tissues is sufficiently far removed to obviate any direct effect of the trauma involved. Through the development of a technique for maintaining appropriate temperature, colloidal and moisture conditions, it has been possible to make prolonged microscopic observations over extended areas of the capillary bed of these visceral structures and to observe the effect of varied experimental procedures[2]. The studies have revealed that the capillary bed is composed of specialized vessels grouped into a series of functional units. The integrated reactions of these units present a picture of the capillary bed as a differentiated organ possessing a highly specific function of controlling locally the supply of blood and the drainage of the tissue. This is accomplished by the peculiar structure and arrangement of the vascular components of the bed and by the highly sensitive reactivity of certain of the components to varying local conditions[3].

The concept developed concerning the visceral capillary circulation may be illustrated by analogy with the irrigation of a field under cultivation. Water is brought into the field by means of one or more main conduits carrying a continuous stream from one end of the field to the other. From these conduits the flow of the water can be regulated, by valves or sluice-gates, into side-canals which lead to all parts of the field. The return of the water is through other side-canals which empty into the lower ends of the main conduits and then to the outlet.

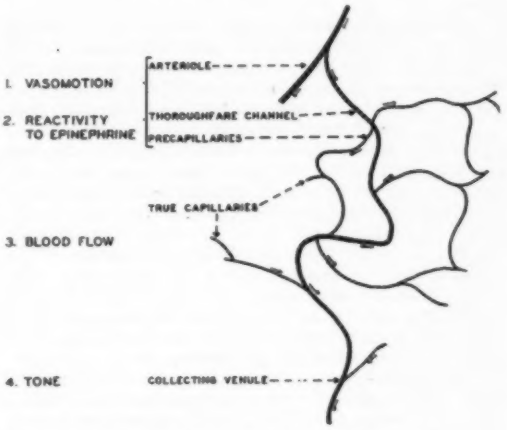

Diagram of a functional unit of a capillary bed

This simile, converted into terms of the capillary bed, is as follows. Well-differentiated, thoroughfare channels as conduits pass from the arterioles to their corresponding venules (see diagram). These channels possess outflowing branches along their proximal portions and inflowing branches along their distal portions. The branches connect with the network of capillaries lying on either side of the channels. The sluices of the capillary irrigation system are the intermittently functioning precapillary sphincters, located where the outflowing side-branches lead off from the upper or arterial segments of the thoroughfare channels. The alternating periods of closing and opening of the sphincters vary from about 20 sec. to 3 min. When the sphincters are relaxed, the precapillaries open up and permit the blood to flow from the channels into the network of the capillaries. When the sphincters are closed, the blood becomes restricted to the thoroughfare channels, which normally are always open and serve to transmit the blood pressure from the terminal arterioles to the collecting venules. Moreover, the continuous flow in the thoroughfare channels aids drainage from the capillary network through the inflowing branches which lead into the lower or venous segments of the channels.

The intermittent closing of the precapillary sphincters does not *per se* normally cause the capillaries of the network to collapse. Drainage, at the venous end, still continues, and, during this period, the capillaries, after being emptied of the corpuscular blood in them, exhibit a flow of a clear fluid which is filtering into them from the surrounding tissue spaces.

In summary, the capillary bed possesses three notable features: (1) a system of continuously flowing thoroughfare channels from arteriole to

venule; (2) intermittently closing sphincteric precapillaries, as abrupt side-branches emerging from the upper reaches of the thoroughfare channels and supplying the network of true capillaries with blood; (3) relatively large postcapillaries entering at acute angles into the lower reaches of the thoroughfare channels. In accordance with the intermittent opening and closing of the precapillaries, the postcapillaries receive at one time blood and, at another, fluid filtering into the true capillaries from the tissue.

In resting ischæmic tissues, the closed periods of the precapillary sphincters are prolonged, during which time the blood courses only through the thoroughfare channels. The capillaries being devoid of blood, the intracapillary pressure falls and fluid filters into them from the surrounding tissue. Thereupon, the postcapillaries, which, similar to the true capillaries, are always open, now transmit a continuous flow of clear fluid into the venous end of the channel, and the tissue tends to be dehydrated.

On the other hand, when the tissue is activated, as in the case of muscle undergoing contraction, the open periods of the sphincters are prolonged. The result of this is a flooding with blood of all the true capillaries and an increase in intracapillary pressure with outward filtration which is accompanied by increased hydration of the tissue[4].

The sphincters are composed of smooth muscle cells, innervated by vasoconstrictor nerves. There is no good evidence for vasodilator innervation, but we do know that many tissue extracts and metabolites cause vasodilatation. On the basis of this we may draw the following conclusion. In resting tissue the metabolites are scanty and are not sufficiently concentrated to prevent the sphincters from responding to vasoconstrictor nerve impulses. Conversely, in activated tissue, the accumulated metabolites cause the sphincters to become refractory to nerve stimulation; whereupon they relax and let blood through. These intermittent, constrictor and dilator phases of the sphincters and of the proximal muscular portion of the thoroughfare channel (metarteriole) constitute a precise mechanism delicately adjusted to the circulatory requirements of the tissues[5].

Having described the capillary circulation under normal conditions, let us consider the effects of acute hæmorrhage and of hæmorrhagic shock. In both, there is loss of fluid, for which the system tends to compensate by a widespread constriction of the larger blood vessels. What happens in the capillary bed? Initially, the reaction is also compensatory. The sphincters contract, preventing egress of blood into the capillary network and restricting the blood to the thoroughfare channels. Meanwhile, the capillary network still continues to drain into the lower reaches of the channels. This serves as an additional compensatory reaction of drawing on the tissue fluid, thus increasing the volume of the circulating blood and causing hæmodilution.

In acute hæmorrhage[6], the compensatory reactions continue until the loss of blood reaches excessive proportions. There is then neither sufficient pressure nor volume of blood to supply the capillaries. The resulting collapse is mechanical in nature and usually not of sufficient duration to affect the vasoconstrictor reactions. There actually occurs an increase in the reactivity of the muscular vessels of the capillary bed which persists almost to the death of the animal. Adequate blood replacement is sufficient to bring about complete recovery.

In hæmorrhagic shock[7], the loss of blood extends over a much longer time. Throughout the somatic structures, in particular, the cutaneous and muscular regions of the body, there is a widespread and pronounced constriction of the blood vessels which continues during the entire shock syndrome.

In the visceral tissues there are initially the compensatory reactions characteristic of acute hæmorrhage. During the early period of the loss of blood, these reactions succeed temporarily in maintaining a good capillary flow. However, the flow gradually deteriorates. Proof has been presented of the existence of a vaso-excitor substance in the blood during the compensatory phase of the shock syndrome, and the predominating presence of a vaso-depressor substance during the later decompensatory phase[8]. This renders the precapillary sphincters refractory to constrictor impulses, whereupon they relax, a condition under normal conditions intended to spread the flow and carry away the accumulating metabolites. However, in traumatic[9] or hæmorrhagic shock the situation is vitiated by the inadequate propelling force and the poor inflow from the greatly constricted arteries. The little blood which now arrives slowly spreads throughout the bed and remains there, aggravating the general oligæmia and intensifying the deleterious effects of the accumulated metabolites.

When this state is reached, the reactivity of the muscular components of the capillary bed becomes depressed to such a degree that it cannot be recovered by the infusion of blood plasma. The impairment of the reactivity upsets the physiological integrity of the capillary circulation. Blood replacement at this stage is not only ineffective but is actually harmful. The infusion now merely dilates the minute vessels which no longer spontaneously possess the power of regaining their contractility. The infused blood then becomes pooled in the peripheral vascular system, and the blood pressure which rose during the infusion falls again as soon as the infusion is stopped. This is the crucial phase in traumatic shock during which a more positive therapy than fluid infusion is required. Preliminary experiments indicate that certain vasotonic agents, which will not intensify the already constricted state of the larger vessels, are effective in extending the recoverability of dogs beyond the state in which the dogs are irreversible to blood infusion[10].

In traumatic shock, involving fluid-loss, Nature's first provision is to drive blood away from the somato-muscular system so that the reduced circulating blood volume may effectively circulate where the blood flow is most needed, namely, the visceral organs. Hence the danger of bringing blood to the skin by warming the patient. When the bleeding patient can be promptly reached, fluid replacement therapy is usually adequate. For the later stages of shock, it is significant that the infusion of blood or of blood plasma has been the preferred treatment.

The study of the capillary circulation in shock has emphasized the need of restoring the reactivity of its muscular components. It has also emphasized the need of a more thorough understanding of the peculiar mechanism which enables the capillary bed to maintain a degree of autonomy from the rest of the blood circulation.

The account presented here is a brief summary of results obtained in association chiefly with Dr. Benjamin W. Zweifach, now of Cornell University Medical College, under grants of the Committee of

Medical Research, Lilly Research Laboratories and the Josiah Macy, Jr., Foundation.

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SCIENTIFIC INSTRUMENTS AT THE COPENHAGEN EXHIBITION

IT was appropriate that the conclusion of an Anglo-Danish trade agreement should have been followed by the exhibition of the products of British industry, which took place in Copenhagen during September 18–October 2. The Danes were thus able to assess for themselves the variety and quality of the manufactures which would be entering their country, in accordance with the terms of the trade agreement, while British exhibitors and visitors were enabled to sample far more freely than has been possible in Great Britain during recent years the Danish produce which was the subject of the converse part of the agreement. One abiding impression of the exhibition is the happy and almost festive atmosphere in which it was staged. Welcome was in the air at Copenhagen —being British was a passport to goodwill. We, on our side, contributed an exhibition of the products of our industry and added for good measure a visit by a contingent of our naval forces, the picturesqueness of the Gordon Highlanders, the spectacle of jet-planes in full flight, and the two-decked utility of British buses. The Danes responded with unlimited enthusiasm, courtesy and hospitality.

The exhibition was spread over a number of buildings in the city, and in one of them, the Gutenberghus, two floors were occupied by a display of scientific instruments. This exhibit took place under the ægis of the Scientific Instrument Manufacturers' Association of Great Britain and included the products of forty British scientific instrument firms. The first comment on this exhibit must not be in respect of the instruments themselves but of the unique and most attractive catalogue-brochure which was produced for the occasion. This brochure took the form of a series of biographies of the exhibiting firms, the types of instruments being produced by any one firm being indicated in the margin, and the illustrations covered one outstanding product of each firm. One gathers from reading this brochure that any British scientific instrument firm celebrating its jubilee is in the 'young person' class of the industry; a firm which can point to a century of activity may lay claim to some measure of maturity. The really firmly established have their origins in the eighteenth or even the seventeenth centuries! The remarkable contribution to the advancement of knowledge made by men of science in Great Britain during the era of modern science has created a continuous demand for the manufacture of scientific instruments as aids to experimentation, and the fulfilment of this demand has meant that scientific instrument manufacture has been a lively activity in Great Britain certainly for three centuries. This fact is worth mentioning for two reasons. On one hand, it has been suggested, and in fact in some quarters assumed, that the traditional home of scientific instrument-making was elsewhere than in Britain. On the other hand, somewhat illogically, instrument manufacture in Great Britain has been criticized on the grounds that it is saturated with tradition and that it has been slow in keeping abreast of modern requirements. The evidence contained in the brochure refutes the one suggestion, and the actual exhibition of instruments at Copenhagen provided a visual demonstration that, whatever truth there may have been at one time in the criticisms of the design and utility of British scientific instruments, such criticisms are no longer valid.

Conversations with those responsible for science and technology in Denmark made it abundantly clear that in the past the term 'scientific instrument' has been synonymous, so far as they were concerned, with 'German scientific instrument'. Very justly they held German scientific instruments in the highest regard, and both their interest in and knowledge of instruments emanating from other countries were practically negligible. It was, therefore, most heartening to hear these same people express considerable astonishment at the range of British instruments exhibited at Copenhagen and to receive their unqualified admiration of the design and quality of the instruments. It would be foolish to decry the excellence of instruments made elsewhere than in Britain. An exhibition such as that held in Copenhagen does, however, make it evident that we shall be carrying our national diffidence of self-advertisement too far if we do not pay tribute to the equal excellence of our own.

The first impression gained by a general survey of the instruments which were shown was that we have travelled a long way since the scientific instrument was, in the main, a tool of the scientific laboratory. One of the exhibits which excited very great interest was a radar equipment, by means of which a display was presented on a cathode-ray tube of the contours —church spires, main streets, harbour installations —of the city of Copenhagen. The home of such an instrument is the bridge of a ship, and the conditions under which it would be of most use are the very antithesis of those to be found in a laboratory. The main use of many of the instruments of greatest precision is in the street or the open country on one hand, or as an attachment to a machine tool on the other. This ubiquity of use, while in no way diminishing the importance of the achievement of the highest accuracy of measurement, has required that the modern scientific instrument shall be characterized by simplicity of operation and robustness in use. A comparison of the instruments shown at an exhibition twenty-five years ago and those recently displayed at Copenhagen would clearly indicate both the revolution and design which has been necessitated by the large extension of the use of instruments, and the remarkable evolution of entirely new types of instruments which has occurred during the last generation. The new principle incorporated in phase-contrast microscopy makes possible

the observation of a wealth of detail within the confines of what were formerly merely nebulous outlines. Incidentally, it has set the microscopist a pretty problem in interpretation. Electronic timing devices have made the pendulum appear a slow and cumbrous thing. The modern spectrograph, a most important industrial tool, has the lines of a gun turret rather than of a delicate scientific instrument. Any exhibition of modern scientific instruments provides both a survey of the growth of scientific knowledge and an indication of the extent to which science has intruded into every sphere of human activity.

The final word on the exhibition of scientific instruments at Copenhagen should be one of congratulation to British scientific instrument manufacturers, who in the short period of three years, after a long period of complete preoccupation with the production of instruments for military purposes, have most successfully reverted to their normal and natural activities. They have done this so completely, and in spite of the abnormal difficulties of the post-war years, that they are now able to meet the scientific, civil and industrial demands for instruments more abundantly than ever before in their history.

INTERNATIONAL UNION OF CRYSTALLOGRAPHY

THE first meeting of the International Union of Crystallography, which was held at Harvard University during July 28–August 3, provided an opportunity for the presentation of papers on many research projects that are being carried out in different parts of the world. More than seventy such papers were read, and there were many detailed discussions.

Some of the sessions—for example, those on "Alloy Phase Structures" and "Proteins and Related Structures"—were held at the same time, and it was therefore not possible for a single observer to attend all of them and so to present an account of the whole conference. Since, in addition, the collection of abstracts alone would occupy more space than could be allowed for this article, it has been decided to describe the work relating to a few topics only. This, unfortunately, means that many papers will not be mentioned at all; but it should be understood that the papers chosen for mention are not necessarily the most important, but are those that the present writer feels competent to knit into a coherent scheme.

It is inevitable that comparison should be made between the states of progress in the various countries represented at the Congress. In the thirty-six years since X-ray diffraction was discovered, many subdivisions of the subject have arisen, and it is interesting to see how these have differently attracted different nationalities. It is, of course, undesirable that some branches of the subject should be ignored in any one country, and, by and large, this has not happened in the countries of major scientific importance; only at such international conferences does any unevenness become apparent. Conversely, contacts made at these conferences should encourage people, perhaps subconsciously, to fill up any gaps that may exist.

These observations were well illustrated by the papers presented at the conference; but unfortunately the comparison can be made only between the United States and Great Britain; the latter had by far the largest foreign delegation and provided about one third of the papers read at the conference, while other countries—India, Canada, Sweden, Holland and Germany—provided only one tenth between them.

Instruments and Instrumentation

The session on instruments was almost entirely American, and this preponderance was evident also in the apparatus that was exhibited. It may be argued that this was naturally so since the conference was held in the United States, but to the writer it did not seem that American superiority was too strongly emphasized; there was some British apparatus on view, and the only important omission was that of demountable X-ray tubes—otherwise all the recent developments were American.

For example, probably the most important recent advance in X-ray analysis is the introduction of Geiger counters for measuring intensities; this may ultimately release X-ray workers from the tyranny of the photographic film. Geiger-counter spectrometers are being made both by Philips Laboratories and the General Electric X-ray Corporation in America, whereas in Great Britain the author is aware of their existence only in more primitive form in certain laboratories. On the other hand, the American apparatus is directed toward the measurement of powder patterns, and, important as this measurement may be for industrial use, it has less theoretical importance than the study of single crystals. It is probable that this latter aspect is as far advanced in Great Britain as in America, but, in general, Geiger-counter apparatus is far more widely used in the United States.

As another example, Great Britain has produced nothing to compare with Buerger's precession goniometer. This instrument gives an undistorted reproduction of a section of the reciprocal lattice and is proving invaluable in the study of crystals with large unit cells. It is true that the indexing of photographs is not a limiting factor in the determination of crystal structures, but any aid to the shortening of this rather laborious operation must be welcomed and may even make practicable certain researches that are at present just outside the bounds of possibility.

In methods of Fourier synthesis, practice in the two countries is at present more or less the same; punched-card machines are greatly used by laboratories that have access to them, and printed strips, with calculating machines, are used by the less fortunate. But this balance is likely to be altered when the electronic machine at the Alabama Polytechnic Institute is completed; this machine should enable a complete two-dimensional Fourier synthesis to be presented instantaneously as an image on a fluorescent screen. With this instrument the major part of the operation will be the setting up of the coefficients; but, once these are set, changes in sign of certain coefficients can easily be introduced. It is possible that this instrument will make practicable the trial-and-error Fourier methods that have so often been suggested but never used.

Two other lines of progress must also be mentioned although they are not concerned with X-rays, namely, electron microscopy and neutron diffraction. Dr. R. W. G. Wyckoff showed electron micrographs of crystals in which individual molecules appeared

stacked together in orderly array. No intra-molecular detail appeared, of course, and it is likely that even the general appearance of the molecule is deceptive; but the fact that single molecules can now be observed is a striking testimony to recent progress with the instrument.

Dr. C. G. Shull gave an account of work on neutron diffraction. In this subject we pass from the orderly world of X-ray diffraction, where the intensity of scattering by an atom depends upon its atomic number, to one in which the intensity of scattering seems to be purely accidental; scattering factors have to be found by experiment and, as an extra complication, certain atoms scatter 180° out of phase with the others. Hydrogen is by far the best scatterer of neutrons, and thus neutron diffraction may settle certain arguments about the positions of hydrogen atoms in some organic crystals.

Crystal Structure Determination

As a contrast to American preponderance in the session on instrumentation, the session on crystal structure determination was largely British; W. L. Bragg and his Manchester school seem to have set a fashion that still persists. This fashion is to treat the problem as a puzzle in which the clues have to be searched for before the analysis can begin. Clues can be of quite different types, but ultimately the evidence they provide must all fit together to give the final answer—the crystal structure.

The work of Mrs. D. Hodgkin and C. W. Bunn on penicillin provides the best example so far of the co-ordination of a number of separate methods. At the conference Mrs. Hodgkin described similar work by J. D. Dunitz on the structure of calciferol (see also *Nature*, Oct. 16, p. 608). The compound used was $C_{28}H_{44}O_4NI$, and 123 parameters were involved. Since the general form of the molecule was known, the problem was not so difficult as the penicillin one, despite the larger number of parameters; nevertheless, the work must be regarded as an outstanding example of the use of heavy atoms in crystal structure determination.

This 'sporting' approach may be contrasted with the more severely logical American approach, which manifests itself in several different ways. For example, there is Buerger's systematization of the methods of interpretation of Patterson sections—the so-called 'implication' method; most workers in Great Britain have been content to derive the information in a rather casual way, which is adequate for simpler structures but may not give all the information that is contained in the sections.

A completely new approach to the general problem has recently been suggested in the form of the 'Harker–Kasper inequalities'. To most people in Britain the method seemed to be of limited utility, but it has been completely justified by its use in the determination of the structure of $B_{10}H_{14}$. Since the method is of greatest use for compounds in which all the atoms are approximately the same weight, it appears to fill a gap left by the development of the 'heavy-atom' methods.

The main recent British contribution to the 'logical' approach is A. D. Booth's use of 'steepest descents', which gives the variation in parameters necessary to improve the agreement between calculated and observed intensities. The method promises to be very useful for refining parameters in known structures, but it has yet to prove its worth in determining an unknown structure.

The 'fly's eye', described by de Vos, Clews and Cochran, provides a more typical example of the British approach. No new principle is involved—merely an appreciation of the relationship between the scattering of light and X-rays—but the apparatus enables the tedious process of calculating structure factors to be eliminated and so enables more structures to be tested than if the calculations had to be done separately for each.

To summarize, it will be seen that rapid progress is still being made in the field of crystal structure determination; still more complicated structures are being brought within the scope of existing methods, and completely new methods are being discovered and brought into use. Structures are being solved that would have been considered quite impossible of solution ten years ago.

Imperfect Structures

Important as the structures of perfect crystals may be, it must be realized that the most important materials, such as biological tissue, are highly imperfect and so their structures do not yield to standard methods of analysis. To these problems there are two methods of approach—the direct, typified by the Astbury school at Leeds, and the indirect, consisting of the study of slight imperfections first, and building on this foundation until the diffraction effects of the more complicated imperfections can be understood. Since the metals provide the simplest structures, it may ultimately appear that the biological problems are settled from an original study of metallic structures.

In this field progress seems to be about the same in both Great Britain and America. Dr. A. J. C. Wilson outlined the theory of diffraction by a one-dimensional imperfection, that for which the layers are perfect but are incorrectly stacked on each other. Examples of such imperfections were cited by Prof. W. Zachariasen, who dealt with the structure of uranyl fluoride, and by Dr. W. F. Bradley, who dealt with clays consisting of two different species of minerals. Imperfections in metals were dealt with by Dr. H. Lipson, who outlined some recent work on single crystals of $AuCu_3$; this crystal gives sharp main reflexions and diffuse superlattice reflexions. In addition, Dr. J. W. Fitzwilliam dealt with the effects of local order in some binary alloys such as $AuCu_3$, AuCu and AgAu.

As a contrast to these investigations, which are capable of theoretical treatment, Dr. H. M. Powell showed a remarkable set of Weissenberg photographs of the various layer lines from an organic crystal; the even layer lines showed sharp spots; but the odd layer lines showed continuous streaks along reciprocal-lattice lines. These effects can be accounted for qualitatively, but quantitatively their treatment is complicated by the complexity of the molecular structure; such photographs provide a striking challenge to the theoretician, and a complete solution of the problem should point the way to treatment of still more complicated imperfections.

The author would like to put on record his thanks to the Council of the Royal Society for enabling him to attend the conference, and to the organisers of the conference for enabling him to extend his stay in order to visit a number of laboratories where the work described in this article is being carried on.

H. LIPSON

OBITUARIES

Dr. C. M. Wenyon, C.M.G., C.B.E., F.R.S.

By the death of Dr. C. M. Wenyon, in London on October 24, at the age of seventy, the scientific world in general and tropical medicine in particular lost one of the foremost exponents of medical protozoology.

Charles Morley Wenyon, son of Dr. Chas. Wenyon, was born at Liverpool on March 24, 1878. He passed his childhood in China, where his father was a pioneer medical missionary, but returned to England for his education. He studied science at University College and medicine at Guy's Hospital, London, graduating B.Sc. (1901) and M.B., B.S. (1904). The dual training in zoology and medicine provided the right background to Wenyon's subsequent activities, and is a clue to the quality of his contributions to medical protozoology, a subject to which he devoted himself from the very beginning of his scientific career. During the first ten years (1904–14), he held with distinction the post of lecturer in protozoology at the London School of Tropical Medicine, where he worked under Patrick Manson. During this period he also continued his studies in Paris, under F. Mesnil, and in Munich, under Richard Hertwig (1906–7), and undertook an expedition for the study of protozoal diseases in the Sudan, where he spent a year (1907–8) working in a floating laboratory on the Nile. He was later (1910–13) sent by the School on missions to Mesopotamia, Syria and Malta, returning with abundant material which formed the subject-matter of important publications on oriental sore and kala-azar in these regions.

In 1914 Wenyon joined the staff of the Wellcome Bureau of Scientific Research as director of research in the tropics. Shortly after the outbreak of the First World War he was seconded—with the rank of lieutenant-colonel, R.A.M.C.—for work under the War Office and proceeded abroad. He carried out important researches on the intestinal protozoal infections, published in Wenyon and O'Connor's "Human Intestinal Protozoa in the Near East" (1917), and on malaria in Greece, the results of which appeared in a series of papers (*J. R.A.M.C.*, 1921–22). In 1924 Wenyon succeeded Sir Andrew Balfour as director-in-chief of the Wellcome Bureau of Scientific Research (now Wellcome Laboratories of Tropical Medicine) and director of research to the Wellcome Foundation, retiring in 1944, but continuing to act in a consulting capacity. Under Wenyon's direction the Bureau developed into a first-class scientific institute enjoying an international reputation among workers in tropical medicine and parasitology.

The variety and volume of Wenyon's contributions to protozoology render their assessment a difficult task. Though by no means restricted to purely medical questions, his work was chiefly concerned with protozoological problems having a direct bearing on tropical diseases. Much of our knowledge regarding the relative medical importance of the intestinal Protozoa and of the epidemiology of amœbiasis is due to Wenyon's pioneer work. He was particularly interested in the transmission of the leishmaniases. Though the credit of solving this problem belongs to others, his own researches and critical reviews of the existing data did much to clear the path for his successors in this field. The most outstanding work published by Wenyon, his *magnum opus*, is the well-known "Protozoology" (1926). This treatise, now generally recognized as a classic, gave a synthesis of our knowledge of the parasitic Protozoa and, though now in places out of date, it remains an indispensable reference book for all serious students of protozoology.

Apart from research work, for many years Wenyon contributed authoritative reviews of the world literature on protozoal diseases to the *Tropical Diseases Bulletin*. The present position of the Royal Society of Tropical Medicine and Hygiene in the medical world and the high quality of its *Transactions* are due largely to Wenyon's untiring efforts during a quarter of a century, first as its honorary secretary and ultimately as its president.

In 1927 Wenyon was elected a fellow of the Royal Society; he received many other honours and awards both at home and abroad.

As a man, Wenyon was universally liked and respected for his friendliness and cheerful disposition. His knowledge and experience were at everybody's disposal, and workers from all over the world, when visiting London, never failed to call on him for advice and help. In his relations with immediate associates there prevailed a happy comradeship, in which 'C. M. W.' was *primus inter pares*. His colleagues will remember with gratitude and affection his constant interest and encouragement in their work and welfare.

C. A. Hoare

Mr. C. A. Hill

Charles Alexander Hill, founder of the British Drug Houses, Ltd., was born in London on August 18, 1874. He was educated at Winchester, King's College, London, and the Pharmaceutical Society's School of Pharmacy. His death occurred on October 23.

C. A. Hill will be long remembered among men of science for the work he did in developing the manufacture of chemicals of high purity for use in research and analysis which began in the 1914 crisis, when it became clear that Great Britain must no longer remain dependent upon importing supplies of these chemicals from Germany or elsewhere.

Hill's natural abilities were well suited to this task; he took a keen interest in science, passionately insisted on accuracy in all matters, particularly in the written or spoken word, and was at all times disposed to devote meticulous attention to matters of detail.

Five years before the First World War broke out, the amalgamation of six companies concerned with pharmaceutical manufacture had taken place under Hill's leadership. Of the resultant company, the British Drug Houses, he had become chairman and managing director. At the outbreak of war, scientific workers throughout Great Britain were made acutely conscious of their dependence upon imported laboratory chemicals, including organic chemicals for use in synthesis, and microscopical stains for use in bacteriology. This challenge made a profound appeal to Hill and he applied his marked organising ability to making good this defect. In the course of the next ten years he achieved a great measure of success in so doing.

Important studies were made in determining the highest obtainable standards of purity for chemicals in this category. New standards were in due course formulated and submitted for acceptance to an independent committee set up for the purpose. The analytical and research laboratories under his direction undertook much work in devising delicate

methods of analytical control; this led ultimately to numerous scientific publications by various members of his scientific staff.

It was a natural corollary to his achievement in setting up the manufacture of laboratory chemicals that Hill worked assiduously in the advocacy of the Safeguarding of Industries Bill, and later for having laboratory chemicals included in the list of goods scheduled under the Act.

Hill's family had long been connected with the Salters' Company; it was during his grandfather's mastership that the Salters' Company set an early example in founding research scholarships. Hill, who became master of the Salters' Company at an early age, was largely instrumental in the formation of the Salters' Institute of Industrial Chemistry, which has as one of its main objects the provision of funds for the training of men entering industrial chemistry.

Hill filled many public offices in connexion with pharmacy and pure and applied chemistry. His published addresses bear witness to his clear thinking and the high standards at which he always aimed. He became chairman of the Association of British Chemical Manufacturers and of the Wholesale Drug Trade Association, president of the British Pharmaceutical Conference, vice-president of the Institute of Chemistry and of the Society of Public Analysts.

The fine-chemical industry of Great Britain, which has undergone great growth during his life, has benefited by his notable contribution to its development.

FRANCIS H. CARR

We regret to announce the following deaths:

Dr. L. Doljanski, head of the Department of Experimental Pathology, The Hebrew University, Jerusalem, on April 13.

Mr. R. Murdin Drake, O.B.E., joint manager of the Association of British Chemical Manufacturers, on November 21, aged forty-five.

Sir John Fryer, K.B.E., F.R.S., secretary of the Agricultural Research Council, on November 22, aged sixty-two.

Mr. J. E. Kingsbury, a founder of Standard Telephones and Cables, Ltd., and an active member of the Society of Telegraph Engineers and later of the Institution of Electrical Engineers, on November 4, aged ninety-three.

NEWS and VIEWS

Nobel Prize for Physics: Prof. P. M. S. Blackett, F.R.S.

THE Nobel Prize for Physics, for the year 1948, has been awarded to Prof. P. M. S. Blackett, of the University of Manchester. The most important of Blackett's contributions to experimental physics have been made with the Wilson expansion chamber. After the discovery of the artificial transmutation of some of the light elements by Rutherford in 1919, it became important to make a detailed study of individual disintegrations, and this could only be done with the Wilson chamber. In order to observe the transmutation of a nitrogen nucleus, it was necessary, however, to consider making many thousands of photographs. For this purpose, Blackett developed the automatic expansion chamber. The successful design and operation of this elaborate instrument, in which the many operations involved in taking a single photograph were made mechanically, in an ordered sequence many times repeated, represented a technical achievement of the highest order. With this instrument, Blackett secured the classical photographs, now familiar to many generations of physics students, showing the disintegration of nitrogen by fast α-particles; and many other examples of nuclear processes.

The experience in design and operation gained with the automatic expansion chamber formed the basis for the next technical advance, the development of the counter-controlled Wilson chamber. If an ordinary chamber is expanded at random, the chance of observing the tracks of particles of the cosmic radiation is very small—in the case of apparatus of conventional design operated at sea-level. In collaboration with G. P. S. Occhialini, Blackett therefore arranged that the expansion should take place only when one or more particles had passed through the chamber. This was secured by a 'trigger' device which operated only if a particle passed through both of two Geiger counters, placed one above and one below the chamber. In this way the beautiful photographs of showers of positive and negative electrons—the 'soft' component of the cosmic rays—were obtained. The principle thus introduced, of combining the particular features of the Wilson chamber with those of the Geiger counter in a single apparatus, continues to be one of the most fruitful methods in the physics of the cosmic radiation. Blackett was also a pioneer in the development of apparatus for studying the deflexion of cosmic ray particles in Wilson chambers operated in strong magnetic fields—a method of great importance for the development of our knowledge of the momenta of cosmic ray particles. This present recognition of his distinctive and original contributions to physics will be welcomed everywhere.

Centenary of H. A. Rowland

NOVEMBER 27 marks the centenary of the birth of Henry Augustus Rowland, one of the most distinguished men of science that the United States has produced. Born at Honesdale, Pennsylvania, on November 27, 1848, Rowland was the son of a clergyman, and at the age of sixteen, after being allowed to abandon his classical studies, he devoted himself to science. He studied to be a civil engineer at the Rensselaer Polytechnic Institute at Troy and graduated in 1870. During the next few years he successively served as a railway engineer, taught in the Wooster College and lectured as assistant professor at the Rensselaer Institute. On April 3, 1876, he became the first professor of physics at the newly created Johns Hopkins University at Baltimore, having the previous year visited Europe and worked for a time under the great Helmholtz. Rowland retained the professorship until his death, adding lustre to the University by his own brilliant researches and by the band of devoted workers he gathered around him.

Rowland's greatest researches were those on the determination of the mechanical equivalent of heat, the determination of the ohm and the study of the solar spectrum. In 1882 he described to the Physical Society his celebrated diffraction grating which placed in the hands of the spectroscopist a new and

powerful instrument of research—one which made it possible to photograph spectra directly without the use of prisms or lenses and with a greatly increased dispersion and resolving power. In 1888 he published a photographic map of the normal solar spectrum, in 1893 a table of standard wave-lengths, and in 1895–97 a table of solar wave-lengths. For his discoveries and investigations Rowland received the Rumford, the Draper and the Matteucci Medals and was honoured in many ways by societies and universities. Besides being a great investigator, he was a great teacher, kindling in his students an enthusiasm approaching his own. His work was always distinguished for refinement and accuracy; and withal he possessed the true scientific temperament. "For myself," he said once, "I value in a scientific mind most of all that love of truth, that care in its pursuit and that humility of mind which makes the possibility of error always present, more than any other quality. This is the mind which has built up modern science to its present perfection, which has laid one stone upon the other with such care that it to-day offers to the world the most complete monument of human reason." Rowland died at his house in Baltimore on April 16, 1901. His body was cremated and his ashes buried beneath his famous ruling engine. His library was in 1903 given by his widow to the Johns Hopkins University.

Mathematics at Ibadan

THE chair of mathematics at University College, Ibadan, Nigeria, has now been filled by the election of Dr. F. V. Atkinson. Educated at St. Paul's School and at the Queen's College, Oxford (of which he was an open scholar during 1934–37), Dr. Atkinson was later a Senior Demy of Magdalen. During the War he served with the Army in India, reaching the rank of major, and he returned to Oxford in 1946 as lecturer in mathematics at Christchurch. Dr. Atkinson's work has been chiefly concerned with the analytical theory of numbers, and the properties of the Riemann ζ-function.

Reading Institute of Education

AN Institute of Education has been established in Reading as the area training organisation for Berkshire, Buckinghamshire, Hampshire, Oxfordshire, West Sussex and Reading. The scheme for the Institute provides for a Board of Governors drawn in equal proportions from the local education authorities in the area and from the University of Reading. The Minister of Education has appointed Sir Frank Stenton, vice-chancellor of the University, as chairman. The principal objects of the Institute are to further the training of teachers and other persons intending to engage in educational work in the area; to foster close relations between the corporate members of the Institute (at present, the University of Reading, the county councils and county borough councils in the area and the training colleges in the area, namely, Culham, Bishop Otter, Easthampstead Park and Newlands Park); and to establish an educational centre for the promotion of the educational interests of students and teachers and other persons professionally concerned with or interested in education in the Institute area. The Institute will be established in or near Reading, and a search for suitable accommodation has already begun; ultimately it is hoped that the Institute will have a new building designed for the purpose. Mr. C. R. E. Gillett has been appointed director of the Institute.

Sources of Technical Assistance

A SURVEY of the technical assistance available for economic development in the United Nations and the Specialized Agencies has been prepared by the secretariat for the second session of the Sub-Commission on Economic Development of the Economic and Employment Commission (London: H.M. Stationery Office. United Nations, E/CN.1/Sub. 3/22. June 2, 1948). Its immediate purpose is to facilitate examination of provisions currently being made for such assistance to members of the United Nations in their programmes of economic development, and particularly to assist the Sub-Commission in considering measures for increasing the availability and effectiveness of such technical assistance. Its scope is limited to those activities, excluding the provision of funds and relief supplies, which are designed to assist economic development; provisions for technical assistance in the sphere of social welfare are not described in detail. The Survey gives a very clear but concise account of the types of assistance available, including that in the form of research and information, as well as international training, panels and conferences; and also of the sources of assistance. It then reviews in succession the various fields such as agriculture, forestry and forest products, fisheries, education and technical training, labour and employment, health, nutrition and safety, finance and currency, or statistics in which such assistance might be required. The Survey contains nothing that is new; but gives a convenient and impressive picture of the elaborate and interlocking organisation for world co-operation which has already been built up, and which could be used if the will to do so were genuine and widespread.

German Hydrographic Journal

REFERENCE was made in *Nature* of September 4, p. 364, to the first issue of the *Deutsche Hydrographische Zeitschrift*. The next two numbers have now appeared: Vol. 1, No. 2/3, June 1948; and Vol. 1, No. 4, August 1948. The former contains articles on problems of marine geology, coastal geodesy, terrestrial magnetism and oceanography, whereas No. 4 is completely devoted to oceanographical and tidal problems. An essay by O. Pratje on the bottom sediments of the southern and middle Baltic and their importance for the interpretation of fossil sediments is based on about a thousand bottom samples which had been collected in the years just before the War. It is accompanied by detailed charts and profiles. F. Rudolf Jung examines the limits of applicability of transit-bearing and of the trigonometrical determination of distances in the technique of marine surveying, and gives numerical and geographical aids for the practical work in question. F. Errulat deals with the mean intensity of great geomagnetic disturbances as dependent on geomagnetic latitude, and finds interesting relations with the results of J. Bartels. G. Neumann writes on resonance-oscillations of bights and on the mouth correction for seiches; his treatment of the Frische Haff agrees well with results which H. Lettau had derived from the registrations of tide gauges. F. Model discusses the thickness of the ice on the Alster in Hamburg towards the end of the severe winter of 1946–47. On the open basin a thickness of 51–56 cm. was found; below a rather broad and low bridge it fell to only 12 cm. G. Wust, studying once again the temperature-inversion in the deep waters of the South Atlantic, finds a remarkably close association

between the inversion and the bottom relief, and points out that the depth of the inversion rises and sinks in accordance with the semi-diurnal tide. There are probably also seasonal and aperiodic pulsations. An important paper by W. Horn gives a concise and partly new representation of the tides as a function of time. G. Tomczak describes a wave gauge, an instrument for measuring short-period oscillations of pressure in the sea, and F. Nusser presents a notable report on ice-conditions on and off the German coasts during the severe winter of 1946–47.

Chemical Prevention of Potato Dry Rot Disease

As a result of research during the past five years, Bayer Products, Ltd., Crawley Research Station, Brighton Road, Crawley, Sussex, claim to have developed a highly efficient preparation for the prevention of dry rot of potato tubers caused by the fungus *Fusarium cæruleum*. This preparation, marketed under the trade name of 'Fusarex', is based on 2,3,5,6 tetrachlornitrobenzene, a chemical first described in 1868 by Jungfleish, who prepared it by treating tetrachlorbenzene with fuming nitric acid for some hours at near boiling point. 'Fusarex' is most effective for the control of dry rot when applied to the tubers immediately on lifting, followed by a period of four to six weeks storage in a clamp. It has been found in trials that the preparation does not need to cover each potato completely so long as an even distribution through the mass of tubers is obtained. Thus a simple manual application can be employed, involving no expense in labour or machinery, and no interference with the normal lifting operations. It has also been found that suitable 'Fusarex' treatment and storage conditions can delay the development of sprouts by the tubers. The treatment of main-crop varieties to prevent sprouting is now a practical proposition; but special techniques are still being worked out for early varieties. Intensive pharmacological tests have shown that tetrachlornitrobenzene is of such a low order of toxicity that it can be regarded as non-poisonous under the conditions of use suggested, and it is therefore safe to use on potatoes destined for human consumption and stock feeding.

Jewels for Instruments

A REVISED edition of "British Standard 904", first issued in 1940, has recently been published (British Standard 904 : 1948. Dimensions of Instrument Jewels. Pp. 12. (London : British Standards Institution, 1948.) 2*s*. net). The forms and dimensions of V-jewels, ring stones and end stones for instrument purposes, and compass jewels, are specified; and in an appendix the method and apparatus required for the inspection of jewels is described. The Standard does not relate to jewels for watches and clocks, for which a separate British Standard is being prepared, nor to cup jewels for integrating meters, the form of which is still the subject of research.

Sun-Bathing by Birds

RECENT communications to *British Birds* have directed attention to the widespread occurrence of the habit of sun-bathing among birds. The question has been raised "whether irradiation of the skin, with its consequent effect of vitamin D production, could take place through sun-bathing". Prof. W. C. Wynne-Edwards has stated that direct irradiation of the skin is usually impossible in both birds and mammals because of their thick coats. From observations lasting over sixteen years, however, Noble Rollin has collected photographs and information which lead him to the belief that irradiation of the skin takes place among jackdaws, chaffinches, blackbirds, hedge-sparrows and house-martins, although no evidence of sun-bathing has been observed among gulls and wading birds (*British Birds*, **41**, No. 10; October 1948).

Science Progress

AMONG the articles in the current issue of *Science Progress* (**36**, No. 144; October 1948) is one which has not only the appeal of a biography of a well-known man of science but also the charm of writing which reminds one of Maurois. This is "Augustin Fresnel: His Time, Life and Work, 1788–1827", by G. A. Boutry, director of the Laboratoire d'Essais, Paris. In the same volume Prof. H. P. Himsworth contributes a masterly survey of recent developments in the researches into liver disease, while E. E. Schneider's review of contemporary knowledge of the electronic structure of solids and H. H. Macey's consideration of the theoretical aspects of clay consolidation are supported by an article on the relationship between "Indeterminism and the Wish" by J. C. Gregory. The volume also contains the usual summary of recent advances in various aspects of science and a considerable number of reviews.

Proceedings of the Physical Society

IN order to accommodate the increased number of papers submitted for publication, the *Proceedings of the Physical Society* is to appear in two parts, *A* and *B*. *Proceedings A* will include a contents list of the corresponding *Proceedings B* and vice versa. Section *A* will include subjects such as quantum theory, statistical mechanics, nuclear physics and cosmic rays, atomic physics, molecules, spectra, theories of solids, liquids and gases, surface phenomena, growth and properties of crystals, crystal structure, luminescence, electrodynamics, heat and thermodynamics, standards. Section *B* will include subjects such as acoustics, including ultrasonics, optical design, electron optics, colour, elasticity and other mechanical properties of solids and liquids, crystal structure analysis, magnetic materials, refrigeration and liquefaction, electric discharges, radio, geophysics, including ionosphere, astrophysics, solar physics.

International Congress of Mathematicians

AN International Congress of Mathematicians will be held in Cambridge, Massachusetts, during August 30–September 6, 1950, under the auspices of the American Mathematical Society. It will be open to mathematicians of all national and geographical groups. Harvard University will be the principal host institution. A number of other institutions in Boston will join in the entertainment of Congress visitors. In recent years, mathematicians have been much impressed by the success of the conference method for presenting recent research in fields in which vigorous advances have just been made or are in progress. The 1950 Congress will include conferences in several fields. Following established custom, there will also be a number of invited addresses by outstanding mathematicians. In addition, sectional meetings for the presentation of contributed papers not included in conference programmes will be held in the following fields: I, Algebra and Theory of Numbers; II, Analysis; III, Geometry and Topology; IV, Probability and

Statistics, Actuarial Science, Economics; V, Mathematical Physics and Applied Mathematics; VI, Logic and Philosophy; VII, History and Education. The official languages of the Congress will be English, French, German, Italian and Russian. Harvard University has offered the use of its dormitories and dining-rooms for mathematicians and their guests for the period of the Congress, and the Organising Committee hopes that it will be possible to furnish board and room without charge to all mathematicians from outside the North American continent who are members of the Congress. Congress membership fees will be announced well in advance of the opening of the Congress. Every effort will be made to facilitate the travel at reasonable cost of foreign participants while in the United States. Communications about the Congress should be addressed to the American Mathematical Society, 531 West 116th Street, New York City 27, U.S.A.

Congress of Comparative Pathology

THE International Congress of Comparative Pathology will hold its fifth meeting in Istanbul during May 17–20, 1949. The Congress covers all aspects of human, plant and veterinary pathology, and considerable latitude is permitted in the choice of subjects for discussion. The British National Committee (chairman, Prof. T. Dalling, Ministry of Agriculture) will be glad to receive, as soon as possible, the titles of communications which members in Great Britain, who hope to attend the Congress, wish to submit for transmission to the Secretaire Générale of the Permanent Committee. Further information can be obtained from Mr. R. E. Glover (honorary secretary, British National Committee), Royal Veterinary College, London, N.W.1, or from Pr. N. R. Belger, Taksim, Siraserviler 75/3, Istanbul.

Commonwealth Fund Fellowships

THE Commonwealth Fund of New York is offering in 1949 a number of fellowships for British subjects to study in the United States for one year. Twenty such fellowships will be available to British subjects between twenty-three and thirty-five years of age, who are graduates of a university of the United Kingdom or who have studied in one, having previously graduated from a university of Australia, New Zealand or South Africa. In addition there are three fellowships for candidates holding permanent positions in the higher ranks of the Civil Service of Great Britain, and five more fellowships for those in Government service in the Commonwealth. The emolument consists of a total grant of approximately 950 dollars with an allowance of 200 dollars a month plus free travel to and from the United States. Applications must be submitted by February 1, 1949, and full details may be obtained from the Secretary of the Committee of Award, 35 Portman Square, London, W.1.

Royal Meteorological Society: Popular Lectures

THE Royal Meteorological Society has arranged a series of monthly meetings, to be held at the Science Museum Lecture Theatre, Exhibition Road, South Kensington, and visitors will be welcome. The first meeting, on December 3 at 5.30 p.m., will consist of a film show, and thereafter popular lectures will be delivered at 6 p.m. by the following speakers on the dates shown: Sir George Simpson, January 12; Sir Nelson Johnson, February 10; Prof. Gordon Manley, March 3; Dr. G. M. B. Dobson, April 6; Mr. E. Gold, May 5.

University of London: Appointments

THE following appointments in the University of London have been announced. Dr. Dennis Gabor has been appointed to the Mullard readership in electronics tenable at the Imperial College of Science and Technology, London, as from January 1, 1949. The title of reader in the University has been conferred on the following: Dr. Vera Fretter, lecturer in zoology at Birkbeck College; Dr. P. A. I. Gorer, of the Department of Experimental Pathology, Guy's Hospital Medical School; Dr. G. E. Newell, lecturer in zoology at Queen Mary College.

The degree of D.Sc. has been conferred on Mr. E. J. Popham, an external student.

The Night Sky in December

FULL moon occurs on Dec. 16d. 09h. 11m. U.T., and new moon on Dec. 30d. 09h. 44m. The following conjunctions with the moon take place: Dec. 2d. 16h., Jupiter 4° N.; Dec. 2d. 17h., Mars 3° N.; Dec. 21d. 09h., Saturn 3° S.; Dec. 28d. 06h., Venus 4° N.; Dec. 31d. 19h., Mars 4° N. In addition to these conjunctions with the moon, Mars is in conjunction with Jupiter on Dec. 1d. 08h., Mars 1·1° S. Mercury rises at 7h. 15m. on Dec. 1, or nearly half an hour before sunrise, but is too close to the sun for observation, and is not favourably placed for observation during the month. Venus is a morning star, rising at 4h. 40m., 5h. 23m. and 6h. 09m. at the beginning, middle and end of the month, respectively. The magnitude of the planet is −3·4 during December, and the visible portion of the illuminated disk varies from 0·84 to 0·90. Mars is still too close to the sun for favourable observation, setting less than an hour and a half after the sun throughout the month. Jupiter is also too close to the sun to be well observed, and is in conjunction with the sun on Jan. 1. Saturn, in the constellation of Leo, rises about 23h. on Dec. 1 and 21h. on Dec. 31; it is visible throughout the morning hours in the early part of the month and also during the later hours of the night in the last part of the month. The planet is stationary on Dec. 17. No occultations of stars brighter than magnitude 6 take place during December. Winter solstice occurs on Dec. 21d. 23h.

Announcements

DR. W. CAMPBELL SMITH, keeper of the Department of Mineralogy in the British Museum (Natural History), has been appointed to the new post of deputy chief scientific officer in the Museum; he will retain his post in the Department of Mineralogy. Dr. Maurice Burton has been appointed a senior principal scientific officer (deputy keeper) in the Department of Zoology.

THE following appointments have been made in the University of Leeds: Mr. W. J. Thomas, as lecturer in agricultural economics; Dr. A. D. Walsh, as lecturer in inorganic and physical chemistry.

THE following have been appointed officers of the Society for Visiting Scientists, 5 Burlington Street, London, W.1: *President and Chairman*, Sir Harold Spencer Jones; *Secretary*, Prof. F. J. M. Stratton; *Treasurer*, Mr. H. R. Walters.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Œstrogens in Grass and their Possible Effects on Milk Secretion

STUDIES of variations in the composition of cows' milk[1,2] have revealed a progressive decline in the non-fatty solids content during the winter months, followed by a substantial and immediate rise when the cows are turned out to grass in the spring. Also it is widely recognized that on 'going out to grass' cows often show an increase in milk yield, greater than the amount ascribable to the extra nutrients ingested.

Attempts to simulate these (galactopoietic) effects of spring grass on milk yield and composition by liberal supplements of carbohydrate, protein or carotene to the ordinary winter rations of cows gave no response, though the characteristic effects were shown when these cows were later given access to spring pasture[3]. It therefore seems reasonable to conclude that these effects are due to the presence in young, rapidly growing grass of a galactopoietic factor such as a hormone or vitamin.

In speculating upon the nature of this postulated galactopoietic factor, we were impressed by the findings of Bennetts and his collaborators[3,4], who observed, in sheep grazing on subterranean clover in Western Australia, histological changes in the reproductive organs of both sexes which pointed to the presence of an œstrogen in the pasture, a conclusion which was later strengthened by the extraction of œstrogen by chemical methods[5]. These findings, taken in conjunction with those of Folley and his co-workers[6,7], who showed that administration of œstrogens will increase the solids content of cows' milk (enrichment effect), indicated the possibility that part at least of the galactopoietic effects of spring grass at the time of maximum growth might be due to the presence of œstrogens. Such a theory would also account for milk yield increases, since the 'enrichment effect' is only one aspect of a general galactopoietic action exerted by œstrogens under suitable conditions[8]. We were thus led to examine the growing herbage of English dairy pastures for the presence of œstrogen.

Samples of herbage cut from a number of pastures during the period of active growth were extracted by a method developed by Mr. T. J. Robinson, details of which were kindly made available by him in advance of publication. The method involves extraction with ethanol, followed by saponification and separation of the phenolic fraction. The extracts were tested for œstrogenic activity by the effect on the weight of the uteri of immature mice, six mice being used in each group. The extracts were dissolved for injection in arachis oil, and the dose given in six subcutaneous injections over three days, with autopsy eighteen hours after the last injection.

The results are noted in the accompanying table; the first series (Nos. 1–7) refers to tests of grasses cut at the early flowering stage in May 1948 at a time when, though plant growth was restricted by adverse weather conditions, cows grazing the pastures showed moderate increases in milk yield and non-fatty solids. The second series (Nos. 8–14) refers to herbage from a number of pastures at the second seasonal cutting on June 23, 1948, and to a hay which was a year old and was included for comparison. This herbage was in the pre-flowering stage. Extracts of the two grass samples in the first series (Nos. 2, 3, 4 and 5) gave significant uterine weight increases over the controls ($P < 0.05$), and the herbage undoubtedly contained œstrogen. The second series demonstrated œstrogen with certainty in the clover (No. 12) and probably in the grasses (Nos. 10 and 11), while the hay (No. 13) was negative.

Serial No.	Treatment	Mean uterine weight (mgm.)
	First series	
1	None	7·8±0·8
2	Grass No. 1: Extract equiv. to 0·75 gm. dry matter	14·2±1·1
3	" " " 1·50 " " "	24·5±2·4
4	Grass No. 2: Extract equiv. to 0·75 gm. dry matter	19·6±1·7
5	" " " 1·50 " " "	20·0±1·2
6	0·03 μgm. α-œstradiol	23·0±1·8
7	0·06 μgm. α-œstradiol	29·3±3·0
	Second series	
8	None	5·3±0·4
9	Arachis oil	6·4±0·5
10	Grass No. 3: Extract equiv. to 0·75 gm. dry matter	8·8±0·9
11	Grass No. 4: Extract equiv. to 0·75 gm. dry matter	9·9±0·8
12	Clover " " " 0·75 " " "	15·1±1·0
13	Hay " " " 0·75 " " "	6·3±0·8
14	0·03 μgm. α-œstradiol	17·4±1·5

These preliminary results are in harmony with the theory that the galactopoietic effects of spring grass in lactating cows may be due to the presence of œstrogen, and justify further work, which is planned, to examine various aspects of the theory in greater detail.

S. BARTLETT
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Atypical Growth, Abnormal Mitosis, Polyploidy and Chromosome Fragmentation Induced by Hexachlorocyclohexane

THE best insecticides and fungicides will be those which kill the plant parasites without affecting the plant organism. In fact, they all affect the host plant more or less in various ways and degrees[1–4]. A series of fungicides and insecticides may have very similar effects on the plant organisms. Ethyl-mercury-chloride (CH_3CH_2HgCl), which is the active substance (2 per cent) of the fungicide 'Granosan', induces atypical growth, abnormal mitosis and polyploidy[3,4], reminding one of the effect of colchicine

and acenaphthene[5,6]. A similar and very strong effect of this kind is produced by hexachlorocyclohexane—another chlor-organic compound—which is the active substance of a series of very effective insecticides, recently recommended under various names. The insecticides 'Agrocides' (7, 3, etc.), for example, the active substance of which is the gamma isomer of 1,2,3,4,5,6-hexachlorocyclohexane ('Gammexane'), induce atypical growth, suppressing the development of the roots, stems and coleoptyles of gramineous plants, producing very striking thickening of these organs, especially of the growing points (root tips and coleoptyles).

Active insecticides, manufactured in various countries (hexachlorane, 666, etc.), and containing several isomers of hexachlorocyclohexane, including the gamma isomer, act in a similar though not in an identical way. Hexachlorane, for example, stimulates the germination of certain Cruciferæ (*Brassica nigra*) and other plant seeds during the first two days, so that they were even ahead in growth, when compared with the control samples, and much ahead when compared with the germinating seeds treated with 'Agrocide 7'. But soon after this, the controls grow on, while the growth of the treated seedlings becomes strikingly suppressed. We have treated with insecticides containing hexachlorocyclohexane the seedlings of the following plants: *Zea mays*, *Triticum vulgare*, *T. durum*, *T. monococcum*, *T. compactum*, *Secale cereale*, *Helianthus annuus*, *Crepis capillaris*, *Vicia faba*, *V. sativa*, *Brassica nigra*, etc.

The cytological studies of the affected root, stem and coleoptyle tissues show that these agents act first of all upon the cytoplasm and interfere with the cytoplasmic processes involved in the formation of achromatic figures. The chromosomes do not arrange themselves in an equatorial (metaphasal) plate after prophase, but remain scattered, as they are during the prophase. They appear less bent than usual. The thickening of the chromosomes, that is, the accumulation of nucleic acids (nucleoproteins) on the chromosomes and the reproduction and splitting of the chromosomes, proceeds, although the processes involved in the formation of achromatic figures are highly disturbed or even entirely inhibited. The chromosomes thus reproduce, but remain where they are, without moving toward the poles. In fact, poles are not formed. After such a reproduction, the chromatolytic (nucleoproteolytic) processes proceed and a nucleus is formed containing twice as many chromosomes as before the beginning of the abnormal mitotic processes. The main trend of the processes of chromosome doubling reminds one of those induced by colchicine, acenaphthene and other polyploidizing agents.

Since the insecticide continues to act further, the next abnormal mitosis ends with a second chromosome doubling and so on. Thus tetraploid and octoploid cells appear, and cells of a much higher degree of polyploidy. Alongside these, certain diploid cells that have not yet undergone the abnormal mitosis can still be found.

Chromosome multiplication leads to increase of the size and occasionally of the number of the nuclei, and further to increase of the size of the cells. Thus the cells grow instead of multiplying and differentiating, leading to swelling of the roots, stems and coleoptyles.

The solubility of hexachlorocyclohexane in water is very low, therefore it is applied as powder. Its effect is so striking that it can be used as a polyploidizing agent, especially when one considers the fact that it is much cheaper than other polyploidizing agents.

In certain cases a chromosome group or groups may move slightly in some direction or directions into the cytoplasm. Such a slight separation may occasionally end with formation of two, or more than two, aneuploid nuclei; thus polynucleate, or cells with monstrously deformed nuclei, appear. In certain cases cell wall is formed between such nuclei. This leads to formation of cells with aneuploid chromosome numbers. Dead cells were occasionally found in the roots, stems and in the coleoptyles. They may have been aneuploid. All these phenomena are due to the activity of the agent upon the cytoplasm.

But the active agent also induces certain changes in the nuclear elements, namely, in the chromosomes, no matter how rarely they may occur. Fragments of one chromatid or of a chromosome (both chromatids) were also observed, although very rarely.

Such insecticides or fungicides, when applied, may increase the hereditary changes in the cultivated varieties ('pure lines'), leading thus to more rapid degeneration of the highly bred uniform varieties. This means that when one applies such insecticides or fungicides, the seeds of the varieties being propagated should be changed more often, so as to provide new non-degenerated stocks.

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Mutations Induced in *Coprinus fimetarius* (L.) by Nitrogen Mustard

DURING recent years, numerous experiments have been performed in order to induce mutations in various fungi belonging to the Ascomycetes group. Of special interest are the mutations affecting physiological characters in *Neurospora*[1] and *Ophiostoma*[2] produced by irradiation, mustard gas or nitrogen mustard. These investigations led me to perform similar experiments with a Basidiomycete, *Coprinus fimetarius*.

In the first experiments, basidiospores from sporophores formed in pure culture were subjected to ultra-violet radiation from a quartz lamp (Original, Hanau), plated out on malt agar, and the developing monosporous mycelia isolated and studied. Even after a very long irradiation, however, the treated spores possessed the same germination capacity as untreated ones, and no morphologically deviating mycelia were observed. Thus the irradiation did not seem to exert any mutagenic effect upon the spores. The surprising resistance might be due to the thick epispore of the *Coprinus* basidiospores, which probably absorbs the ultra-violet rays.

Treatment with nitrogen mustard ($(Cl.CH_2.CH_2)_2N.CH_3$), on the other hand, gave positive results. In the first of the two experiments with this compound, the spores were suspended in a 0·25 per cent solution of nitrogen mustard at *p*H 5·6. After 30 min. the treatment was broken off by diluting the suspension

twenty-five times and plating out the spores on malt agar plates. The percentage germination was 2·4 per cent compared with 25 per cent in untreated spores. From the plates, 462 monosporous mycelia were transferred to flasks containing 5 ml. of a synthetic nutrient solution ('minimum solution') giving optimal growth for *C. fimetarius*, wild type[3].

Many of the spores treated with nitrogen mustard developed morphologically deviating mycelia; but only the physiologically deviating mycelia, however, were more closely studied. The mycelia which did not develop in the minimum solution were transferred to malt agar tubes and their specific requirements examined. Three physiological mutations (0·6 per cent) were found, two of which (Nos. 23 and 32) required hypoxanthine or adenine for growth; the third mutant (No. 17) requires an as yet unidentified amino-acid, or a combination of amino-acids.

In the second experiment, the spores were treated with 0·5 per cent nitrogen mustard. The percentage germination was 1·9 per cent (against 32 per cent in the control), and 454 mycelia were isolated. Two of them (Nos. 54 and 78) were mutants, both growing with methionine or cystein, and thus probably representing induced parathiotrophy (Volkonsky[4]).

In one case, No. 32 (hypoxanthine-less), the inheritance of the induced character was studied. *C. fimetarius* being a tetrapolar, heterothallic fungus[5], four test mycelia (Nos. 7, 3, 5 and 1) could be isolated representing the mating types a_1b_1, a_2b_2, a_1b_2 and a_2b_1, respectively. No. 32 conjugated with No. 7 (a_1b_1), and the dicaryotic mycelium formed was inoculated into a flask with sterile horse manure. Despite the fact that half the nuclei in the mycelium were hypoxanthine-less, several normally shaped sporophores developed in the flask in eleven days. Spores from them were plated out on malt agar, and 46 monosporous mycelia were isolated; 21 of them turned out to be hypoxanthine-less, the remaining 25 representing the wild type. The hypoxanthine-less mycelia were segregated into all the four mating groups, three mycelia representing a_1b_1, six a_2b_2, three a_1b_2 and nine a_2b_1. To judge from these figures no strong linkage seemed to exist between the mutated gene and the incompatibility factors, *a* and *b*.

A back-cross between No. (32 × 7)11, a_1b_1, and No. 32, a_2b_2, gave a completely hypoxanthine-less dicaryotic mycelium, which grew well on sterile manure but did not form any sporophores.

The hypoxanthine-less No. 32 (a_2b_2) and the parathiotrophic No. 54 (a_1b_1) conjugated and formed a dicaryotic mycelium capable of growing in the minimum medium just as well as the wild type. This mycelium obviously represents a case of 'intracellular symbiosis' analogous to the heterocaryotic mycelia of *Neurospora*[6], but probably differing from them in that the two sorts of nuclei always occur in equal numbers, because of the conjugate divisions. Sporophores were formed on sterile manure, but no spores have as yet been obtained.

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Some Stereochemical Aspects in Genetics

IT is a fundamental concept in modern chemical genetics that a separate gene is responsible for each step in the enzymatic biosynthesis of a given compound. Since *in vitro* the precursor (or precursors) of the compound would also be able to produce substances other than that formed in the tissue, a gene, as is well known, displays a chemical steering power which is directed toward a single structural target.

We suggest that in the evaluation of the degree of selectivity in this steering function of some genes, one has to go further than usual by thinking in stereochemical rather than in purely chemical terms. In the case of those carbon compounds which are able to assume two or more *cis-trans* forms, their biosynthesis can be effectively steered in the tissue towards a single spatial model. This can be demonstrated in the field of the carotenoids, which are produced annually on the hundred-million-ton scale in the vegetable kingdom. In the overwhelming majority of the plants, only the all-*trans* configuration appears. For example, during the biosynthesis of lycopene in the ripening of ordinary tomatoes, this particular configuration is selected out of the seventy-two stereochemical possibilities, and none of the other seventy-one stereoisomers can be found in fresh extracts by careful adsorption analysis.

That a stereochemical steering factor must be made responsible for this spatial selection and not an excessive lability of all *cis-trans* isomers neglected *in vivo* follows from the appearance, in exceptional cases, of such poly*cis* forms of lycopene, which can be crystallized easily and show a degree of thermostability similar to that of the all-*trans* compound. The first such reported case was the occurrence of 'prolycopene' in the 'tangerine' variety of tomatoes[1].

There are three genetically different flesh colours known in tomatoes: yellow, orange and red. The yellow fruits carry the recessive form, *r*, of the basic gene for lycopene formation. Both the orange and red fruits possess the dominant gene, *R*. In addition, however, the orange-coloured tomatoes, which contain the poly*cis* compound, prolycopene (besides other *cis* lycopenes), is recessive in the gene *t*; and the red fruit which exclusively produces the all-*trans* form of lycopene has dominant *T*. Whereas the biosynthesis of either all-*trans*-lycopene or prolycopene requires the dominant gene, *R*, the gene pair *T* and *t* determines the spatial configuration of the lycopene molecule[1].

We expect that other instances may be found in which one gene is responsible for the building up of the chemical structure proper of a compound, and another gene steers the molecules thus formed into a predetermined stereochemical configuration.

A spatial difference (*cis* or *trans*) around a double bond does not modify only a detail in the polyene molecule but also, as models show, it profoundly changes its overall shape[2]. While an all-*trans*-lycopene molecule has a rod-like form, this becomes a V-like pattern when a centrally located double bond assumes *cis* configuration. Again, when several more such rearrangements take place around other double bonds, the molecule straightens out.

Of course, not each of the sterically possible geometrical forms of a given compound can fit equally into a biological system. Hence, it is an important function of some special genes to secure the most suitable spatial configuration; however, if a com-

pound is not subject to stereoisomerism, its genetics can be satisfactorily treated in terms of two-dimensional structural chemistry.

While so far our discussion has referred to the morphology of single molecules of relative simplicity, some bio-processes which consist of arranging many building stones into high-molecular complex structures may also be considered on similar lines. One can conceive a difference between such genes the function of which is to link building units together, and others which arrange the biosynthetic end-product into a predetermined spatial pattern. The first type of genes, which are being studied with so much success, for example, in the case of *Neurospora*[3], determines the chemical composition of the tissue; but the second type is concerned with the organic form. It may also determine the spatial relationship of the constituents within a cell or the specific arrangement of molecules into some micro- and macroscopic structures. In this respect one should also consider genes which affect the symmetry of organisms. An interesting example is that of a freshwater snail in which the direction of coiling of the shell is genetically determined by a single gene-pair[4].

The original concept of the gene took into account both its effect on chemical composition and form. While important modern studies are stressing typical biochemical effects in genetics, recent stereochemical observations on some natural pigments may contribute to the emphasis on the three-dimensional form, that is, the genetically predetermined spatial shape of both simple molecules and complex organic structures.

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Local Action of Calciferol and Vitamin A on Bone

It has been shown[1] that if the parathyroid glands of young mice are attached to small, excised pieces of parietal bone, and the two grafted together to the cerebral hemisphere of a litter-mate, intense osteoclastic resorption of the bone in the immediate vicinity of the gland is demonstrable after 10–14 days. The same method has now been used to study the local action of calciferol, vitamin A and œstradiol on bone.

The small crystals of powdered calciferol were cemented together into lumps about 0·5 mm. in diameter with human fibrinogen and thrombin solutions, and these pellets were attached with the same medium, plus penicillin, to the centre of pieces of parietal bone 2–3 mm. square, cut from 10-day-old *C.57* black mice. The grafts were thrust vertically into the cerebral hemisphere of a litter-mate through a narrow hole made in the skull and were examined in saline after 10–14 days. Similar experiments were performed using cholesterol. In some cases the crystal-pellet could be seen after removal, and its position correlated with the structure of the adjacent bone as revealed in the dry specimens after maceration in potash. In other cases the pellet was displaced or detached in removal. The three 14-day calciferol grafts (Fig. 2) all showed very definite resorption in the central region, corresponding closely to the site of the crystals, and in two of them the bone was perforated. The five 10-day grafts also showed definite, but less pronounced, erosion. In all specimens resorption was irregular and appeared to involve the widening of pre-existing spaces and foramina over a fairly large area. The cholesterol grafts (Fig. 1), in contrast, showed no evidence of local resorption, the bone surface being smooth and dense, and with a certain amount of irregular thickening, particularly at the periphery; previous experience shows this to be common in all types of grafts with parietal bone, even if no crystals are attached. The experiments strongly support McClean's[2] suggestion that the osteoporosis which results from massive doses of calciferol is due, at least in part, to a local action of the vitamin on the bones.

Six grafts performed with single small chips of crystalline vitamin A acetate showed intense and more sharply localized resorption after 14 days. Four of them (Fig. 3) were perforated by a large hole, at the sharp edges of which osteoclasts could be seen after supravital staining with neutral-red in the manner I have described[3] previously. Two others showed a concave depression formed of thin bone, with minute perforations in some regions of it. Neutral-red staining revealed approximately 150 osteoclasts spread over each of these concavities, which are apparently due, as in parathyroid grafts, to new bone formation on one surface keeping pace with resorption on the other. The sharpness of the perforation as compared with calciferol grafts may be due to the use of a single fragment, which was therefore not interpenetrated by fibrin. It is very unlikely that the effect is due to mechanical pressure, since

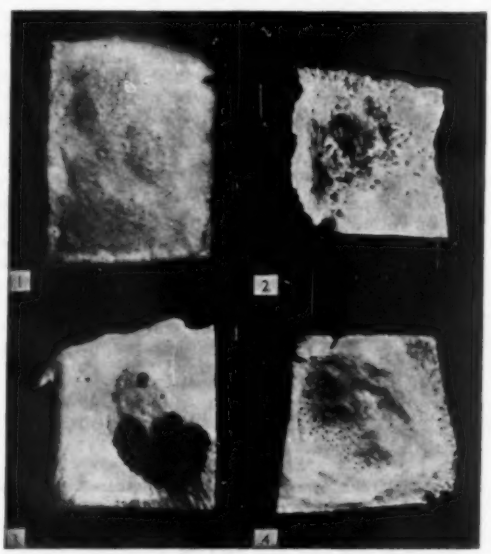

Fig. 1. Cholesterol graft. Fig. 2. Calciferol graft.
Fig. 3. Vitamin A graft. Fig. 4. Vitamin A graft.

fragments of glass did not produce resorption, and in one specimen the glass became closely embedded in the bone surface without perforating it. The local reaction of the bone to the pressure of a grafted fragment may, of course, be modified if the fragment also exerts a physiological effect by virtue of its chemical character. Grafts performed with carotene, made up in fibrinogen–thrombin clot, showed no resorption or other noteworthy effect. It appears that the fractures observed by Moore and Wang[4] and others in rats given massive doses of vitamin A may be attributable to local action on the bones, and the results are interesting in relation to Mellanby's[5] findings on the effect of vitamin A deficiency on osteoclasis. As might be expected, carotene is evidently not converted to vitamin A by bone tissue, at least to any considerable extent.

Ten grafts (five into male and five into female hosts), using small single chips from a fused œstradiol tablet, showed no evidence of either local resorption or increased local bone deposition. Increased deposition might, perhaps, have been anticipated in view of the known action of injected œstrogens in promoting bone-formation in the medullary cavities of the long bones. Sutro[6] claims that osteosclerosis of the calvarium also occurs in young mice of either sex given prolonged œstrogen treatment. The character and degree of the response to œstrogens apparently varies in different regions of the skeleton: thus the pubic bone undergoes resorption; in the long bones only endosteal bone formation occurs; and the magnitude of the effect depends on dose – time relations. Further graft experiments, taking these factors into account, will be needed before the local action of œstrogens can be satisfactorily assessed.

The detailed results, including histological findings, will be reported elsewhere at a later date.

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Effect of Pantothenic Acid on the Infection of *Trypanosoma evansi* in Rats

Withholding of pantothenic acid from the diet has been shown by Becker, Mansera and Johnson[1] to interfere with the production of ablastin, the trypanosome-reproduction inhibiting antibody, formed by rats infected with *Trypanosoma lewisi*. An investigation of exploratory nature was undertaken to ascertain if pantothenic acid had a similar effect on the course of *T. evansi* infection in rats.

Experiment 1. Six rats, all kept on bread and milk, were used in this experiment. The diet of three of these was supplemented by pantothenic acid at the rate of 200 mgm. a rat daily for five days prior to infection and continued until the end. All the rats were infected on the same day with 3,000 trypanosomes each by the subcutaneous route. On the fifth day after infection, two out of three rats of the control batch showed trypanosomes in their peripheral circulation, while all three of the acid group remained negative. On the sixth day, only two rats of the acid group showed trypanosomes in the tail blood, while the third remained negative; in all the controls the parasites were swarming in the blood, and one died during that night. On the seventh day one rat of the acid group died, while two others had a rise in the number of parasites; controls showed an even greater number and died during the night; the remaining two of the acid group, on the other hand, died twenty-four hours later.

Experiment 2. The dietary and other conditions were the same as above; but the dose of the trypanosomes was increased to 46,000 a rat. The rats of both groups became positive on the third day; but the number of parasites in the controls was appreciably larger than those receiving pantothenic acid. One control rat died on the fourth day and the remaining two during the night; in the acid group, on the other hand, all three showed swarming parasites on the fourth day, survived the fifth day and died during the night.

Experiment 3. The conditions were slightly varied. A batch of ten rats was kept for fifteen days on a vitamin-free diet consisting of casein (vitamin-free), 20 parts; coco-nut oil, 5 parts; dextrinized starch, 71 parts; salt mixture (Osborn and Mendel), 4 parts. Five of these, in addition, received pantothenic acid as above. On the sixteenth day the rats received a dose of 2,500 trypanosomes each subcutaneously. In the control batch two rats were positive on the fifth day and all on the sixth day; while in the acid group one became positive on the sixth day, and with an addition of one on each day to the positive group, all were positive by the tenth day. Commencing from the night of the tenth day, all the controls died within the next forty-eight hours; whereas in the acid group the first death occurred on the twelfth day and within the next forty hours all were dead.

Though further experimental observations have yet to be made before any generalization can be attempted on the subject, the results presented here are interesting enough to merit publication. The results perhaps justify a tentative suggestion that pantothenic acid exerts an influence on the rate of multiplication of *T. evansi* in rats, although finally the host is overwhelmed by parasitæmia.

Bovines in India are considered to be 'carriers' of *T. evansi*, and the pantothenic acid reserve in these animals may play the important part of maintaining the 'carrier' condition. Sporadic fatal outbreaks of surra in bovines are, however, not uncommon in India, and the cause for this may perhaps be found to be correlated with the interference of pantothenic acid balance in these animals.

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Role of the Inorganic Constituents of Wheat Bran Extract in Streptomycin Production

WHEAT bran has been frequently used as an ingredient in media for culturing micro-organisms. Good results have been recorded from this laboratory for penicillin production by *P. notatum*[1] and streptomycin formation by *S. griseus*[2]. Detailed systematic investigations carried out to discover the factors in wheat bran extract responsible for these results have shown that the ash of the extract is mainly concerned so far as streptomycin is concerned.

Streptomycin fermentations were conducted in a manner described previously[3]. Streptomycin titre and the reaction of the culture fluids were studied daily. Antibiotic activity was determined from a standard curve obtained by the cup plate method. The following media were used :

I. Aqueous extract of wheat bran with total solids adjusted to 2 gm. per 100 ml. ; pre-adjusted to *p*H 6·8.
II. 'Difco' peptone, 0·5 gm. ; glucose, 1·0 gm. ; sodium chloride, 0·5 gm. ; distilled water, to 100 ml. ; pre-adjusted to *p*H 6·5–7.

The inoculum consisted of a spore suspension of a Waksman's strain of *S. griseus*. The ash of the wheat bran extract was obtained by heating the total solids in an electric furnace at a temperature of about 1,000° C. for 10–14 hours. No attempt was made to dissolve the ash before adding it to the medium.

The accompanying table shows that addition of the ash at 500 mgm. per 100 ml. to medium II increased the streptomycin production to practically the same as that when *S. griseus* was grown in medium I. The ash content of medium I is 453 mgm. per 100 c.c.

Effect of wheat bran extract ash on streptomycin formation

Medium	Ash in medium (mgm./100 c.c.)	Reaction of medium (days)						Streptomycin in μgm. per ml.					
		4	5	6	7	8	9	4	5	6	7	8	9
I	Nil	7·1	7·2	7·6	7·7	7·9	7·9	69	111	114	109	92	91
II	Nil	6·9	7·4	7·4	7·5	7·6	7·6	24	24	25	28	24	24
	100 mgm.	7·1	7·2	7·3	7·4	7·6	7·9	24	28	36	64	64	48
	200 ,,	7·3	7·3	7·4	7·6	7·8	7·9	22	28	45	78	76	78
	400 ,,	7·4	7·5	7·6	7·8	7·9	7·9	28	28	54	98	85	88
	500 ,,	7·5	7·6	7·8	7·9	7·9	7·9	25	28	61	108	93	92

A similar observation regarding the role of inorganic constituents of corn-steep liquor in penicillin formation has been recorded[4]. Recently fatty acid-like components have been isolated[5] from solid wheat bran, and it has been suggested that these might explain the good antibiotic production by micro-organisms in wheat bran. Neither the aqueous extract of wheat bran used by us nor its petrol-soluble fraction has shown any antibacterial activity. The data presented above suggest that the good yields obtained by using the bran or its aqueous extract is independent of any influence likely to result from the antibacterial activity of the fatty acid component of the bran. Further work regarding the role of the different elements present in the ash is in progress.

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Inhibition of a Succinic Aerodehydrogenase System by Surface-active Agents

A NUMBER of detergents of different types have been found to depress the oxygen uptake of a homogenate of rabbit liver in presence of succinate (see accompanying table).

Compound tested	Class of detergent	Oxygen uptake l/ml./30 min.	Concentration of compound	% Inhibition
Sodium cetyl sulphate	anionic	45	*M*/1,5000	70
			M/7,500	16
Sodium salt of *iso*-propyl-substituted naphthalene-sulphonic acid	anionic	100	*M*/300	62
			M/1,500	25
Bile salts. (Sodium taurocholate, sodium glycocholate, mol. wt. taken as 500)	anionic	52	*M*/300	97
			M/1,500	39
Cetyl polyethylene-oxide	neutral	54	*M*/7,500	88
			M/200,000	33
Cetyl trimethyl ammonium chloride	cationic	131	*M*/500	98
			M/2,500	40
			M/12,500	−32*
Dodecyl pyridinium bromide	cationic	97	*M*/500	100
			M/2,500	−22*

* Stimulation of 32 and 22 per cent respectively.

The functioning of the enzyme system studied appears to be profoundly disturbed by a change in the surface activity of the preparation irrespective of the specific nature of the substances producing this change.

My thanks are due to I.C.I. (Dyestuffs), Ltd., for gifts of chemicals.

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Vascular Wilt Disease of Oil Palms in Nigeria

IN 1946, I observed and diagnosed a vascular wilt disease of oil palms (*Elæis guineensis*) in the Belgian Congo, a strain of *Fusarium oxysporum* being consistently associated with the necrosed wood vessels[1,2]. An investigation in 1947 of diseased oil palms in various Nigerian plantations by Messrs. S. de Blank and F. Ferguson, of the United Africa Co., led them to the conclusion (private report) that vascular wilt disease was also present in Nigeria. Cultures which they submitted to me for identification consisted of strains of *F. oxysporum* very similar to those which I obtained in the Belgian Congo. During the present year, in an inspection of oil palm plantations in Nigeria, I obtained full confirmation of the presence of vascular wilt disease. Some plantation areas show how severe this disease can be, many 8–12 years old palms being killed off, together with the younger replacements. An important addition to our knowledge is that infected vascular strands can be observed in seedlings 18–24 months old : from these, *Fusarium oxysporum* and other species of *Fusarium* have been isolated. This fact may materially shorten the programme of breeding resistant varieties.

In Nigeria, as in the Belgian Congo, a leaf disease known as patch yellow has also an associated strain

of *Fusarium oxysporum*, this strain being different from that isolated from necrosed vascular strands[2].

These observations give me an opportunity of saying that, broadly speaking, the major plantation problems are common to the whole oil palm region of West and Central Africa. Accordingly, it is to be hoped that the closest co-operation will be maintained by all bodies interested in the welfare of this important industry.

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Bacteriophage Typing of Untypable *Salmonella typhi* Organisms

STRAINS of *S. typhi* reported as being untypable by bacteriophage figure largely in previous reports and vary between 30 and 8 per cent of the total[1].

Using a modification of the method described by Craigie for typing, the group of untypables can be divided into three more or less distinct sub-groups. The first is characterized by all specimens from the same source of infection giving a standard pattern throughout with certain Type II bacteriophages. This pattern reaction identifies the close relationship of the strains to one focus, but does not allow the strains to be classified into any one of the recognized twenty-four groups. The second subgroup, and the larger in my series, are strains which give no reaction with Type II 'phages, but react to pooled Types I and IV 'phages with clear, complete, confluent lysis. These types may easily be considered to be new types; but with the technique to be described, most can be classified into the existing ones. The third group are those in which Types I and IV 'phages have little or no reaction, although the organisms may or may not have a *Vi* antigen content.

From a series of symptomless carriers in one area there were isolated 'rough' typhoid organisms, suggested by the biochemical findings, for they were auto-agglutinable in both normal and 0·2 per cent saline solution. Observation of the cultures showed them to be heavily contaminated with a naturally occurring anti/*O* 'phage. When the 'phage content was reduced in amount, the agglutinations were characteristic, and the organisms reacted with confluent lysis to I and IV 'phages and also were all lysed by specific Type II *G* 'phage. This series was presumed to be an example of excessively 'phage-contaminated Type *G S. typhi*, which had spread from one person to another in the roughened form.

This technique of growth in anti-phage serum was applied to a series of previously untypable strains, and most of them have now been assigned to known 'phage types. Most difficulty arises with the sub-group characterized by its pattern reaction, for although these strains can be altered to the second group (that is, lysis only with pooled I and IV 'phages), so far it has not been easy to classify them further.

These three subgroups would seem to be due to the same biological process in action. The groups are not clear cut and merge into one another. The individual variation of *V — VW — W* seems to run parallel to the colonial population change of smooth to rough in that the roughness is due to the same process acting on smooth organisms.

It would seem that bacteria contaminated with bacteriophage show the phenomenon of partial and complete interference to specific 'phage action. The loss or lowering of bacterial resistance to concomitant 'phage is responsible for the change from *V—VW—W* and even to *rho* forms. Outbreaks of typhoid fever have occurred, where the *S. typhi* isolated gave partial or complete interference to specific 'phages and rendered the organisms untypable, in that they could not be assigned to group 1—24. It is of interest to note that untypable forms occur towards the end of outbreaks caused by specific 'phage types. When these previously untypable strains are rendered typable by the above method, they are found to be of the same 'phage type as the outbreak. As with communities, so with individuals, it is not infrequent that in a clinical relapse the organism isolated is of the untypable group. Examples of these untypable *S. typhi* from relapses have been identified as being of the same 'phage type as the initial infection.

Bacteriophage is widely distributed in Nature. Among the Gram-negative bacilli, 'phages have been isolated here from *S. typhi*, paratyphi *A*, *B* and *C*, various other members of the *Salmonella* group, most strains of dysentery, *Proteus*, *Pyocyaneus* and Coliforms, and they are especially numerous on Paracolon organisms. It would seem as if most of these organisms have the weakness whereby they lose their resistance to 'phage and become contaminated. From this point of view, it is not happy symbiosis, for the contamination alters the organism.

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Distribution of Shell Porphyrins in Mollusca

RED fluorescence due to porphyrins in molluscan shells has been known for some years (Furreg and Querner, 1929; Fischer, 1930, 1934, 1937; Waldenstrom, 1937; Tixier, 1945); but its exact distribution has not been described. In an investigation of the phylogenetic relationships of shell pigments, I have examined some three thousand species from many gastropod and pelecypod genera by ultra-violet fluoroscopy. Detailed findings in this investigation, together with data on the chemistry of shell porphyrins and other acid-soluble pigments, will appear in due course in the *Biochemical Journal*.

The distribution of porphyrins follows the known anatomical affinities of molluscs very closely. They occur widely in the Archæogastropoda, but disappear among the Turbinidæ, in which Krukenberg (1883) and Tixier (1947) have demonstrated a predominance of linear tetrapyrroles, and are absent from the Mesogastropoda as far as the Lamellariacea. A focus of porphyrin deposition covers this section and overlaps into the Cypræacea. The characteristic fluorescence recurs in the tectibranch opisthobranchs and in *Umbraculum*. Isolated species of *Marginella*, and one species of *Torinia*, also deposit porphyrins. Among the pelecypods, I found them in the Anomiidæ, Pinnidæ and Pteriidæ, and in *Venus* (*Clausinella*) *fasciata*, *Gafrarium divaricatum* and *Sunetta solanderi*.

They were absent from other pelecypods examined. No porphyrins were detected in the shell of any land form, or of any freshwater pulmonate.

The main genera in which shell porphyrins have been shown to occur are listed below, the sign • indicating that the property is widespread in the group.

Clypidina	*Monodonta*	*Hydatina*
•*Fissurella*	•*Angaria*	•*Bulla*
Lucapina	*Leptothyra*	*Acteon*
Acmæa	*Lithopoma*	*Haminea*
•*Trochus*	*Tricolia*	•*Aplustrum*
•*Clanculus*	*Theodoxus*	•*Umbraculum*
•*Ethalia*	*Neritodryas*	*Enigmoma*
•*Isanda*	*Neritina*	*Anomia*
•*Monilia*	*Torinia*	•*Pteria*
Thalotia	•*Trivia*	•*Pinctada*
Elenchus	•*Erato*	•*Malleus*
•*Umbonium*	•*Velutina*	*Isognomon*
Gibbula	*Cypræa*	*Pinna*
Livona	*Marginella*	*Venus*

They occur also in several Loricates, and in two Scaphopods.

Distribution in the outlying groups is well localized: in *Cypræa* it is confined to the section *Luria* (*cinerea*, *isabella*, *pulchra*), *Erronea subviridis* and *Cypræa mappa*. In *Marginella*, it centres round *M. ornata*. Individual variation is very marked. The pattern of distribution in an individual species may or may not coincide with the visible pigment; in some forms it is generalized, in others confined to a single band or patch. In *Gibbula cineraria*, only the topmost whorl and protoconch usually fluoresce.

The porphyrin content of most forms is chromatographically separable from the main colouring matter. Details of the pigments detected, which are numerous, and of the identity of the porphyrins, will be given in forthcoming papers.

Marked porphyrin fluorescence was detected not only in *Gibbula cineraria* from the Clyde Beds (post-Pleistocene), but also in *Pteria media* from the London Clay and several species from the Calcaire Grossier (Paris Basin, Upper Eocene), namely, *Fissurella squamosa* Desh., *Angaria calcar* Lk., *A. lima* Lk., *Tectus crenularis* Lk.

The following is a list of British recent Mollusca found to deposit shell porphyrin:

Patelloida virginea Mull.	*Velutina velutina* Mull.
Gibbula magus da C.	*Erato voluta* Mont.
Gibbula cineraria L.	*Trivia monacha* da C.
Cantharidus striatus da C.	*Trivia arctica* Mont.
Monodonta lineata da C.	*Acteon tornatilis* L.
Tricolia pullus L.	*Venus fasciata* da C.
Theodoxus fluviatilis L.	

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Oscillographic Analysis of the Gravity and Vibration Responses from the Labyrinth of the Thornback Ray (*Raja clavata*)

IN a recent communication[1], one of us (O. L.) reviewed the results so far obtained, by the oscillographic method, in the study of the non-acoustic function of the vertebrate ear. In that review a preliminary account was given of the reaction to gravitational stimuli and linear accelerations of the otolith organ in the recessus utriculi of the elasmobranch labyrinth. It was shown that the otolith organ of the utriculus is sensitive to positional changes about any horizontal axis, and to linear acceleration during straight-line translations. The fact that the organ is not restricted to respond to displacements in only one plane of space invited the conclusion that the utriculus may well be the only otolith organ concerned with the maintenance of equilibrium, leaving the otolith organs of the pars inferior of the labyrinth (sacculus and lagena) free for the reception of vibrational stimuli. This function has, in fact, been conclusively demonstrated to be localized in the pars inferior of the labyrinth of bony fish[2,3].

During the past summer we have been able to extend our electrophysiological experiments on the labyrinth of the ray to the pars inferior, and we have succeeded in obtaining, by direct recording from the nerve branches supplying all its sensory epithelia, single-fibre responses of accurately localized origin. The results, the quantitative aspects of which are at present being analysed and prepared for publication elsewhere, can be qualitatively summarized as follows.

In the elasmobranch labyrinth the utriculus is not the only gravity receptor. Equally good but qualitatively different gravity responses can be recorded from the otolith organs of the sacculus and of the lagena. In the lagena the whole macula acts as a gravity receptor, whereas in the sacculus gravity responses are confined to the posterior part of the macula immediately adjoining the lagena. The lateral part of the sacculus macula, which is innervated by a number of separate branches of the ramus inferior of the eighth nerve, shows clear and characteristic nerve-impulse responses to low-frequency vibrations of the substrate. These spike responses are accompanied, but in our opinion not caused, by the well-known Wever–Bray or 'cochlea' effects, which can always be picked up from the membranous wall of the exposed labyrinth during vibrational stimulation[2-7].

Apart from the lateral part of the sacculus macula, the sacculus was found to contain yet another highly sensitive vibration receptor. This is the macula neglecta, which is lodged in the medio-dorsal aspect of the sacculus and is innervated by a separate long nerve branch, containing relatively thick and therefore rapidly conducting fibres. The sensorium of the macula neglecta is small and not covered by a lime-encrusted otolith membrane. It lies opposite a large membrane-covered window in the dorsal wall of the cranium, which was first described by Scarpa[8] as fenestra ovalis, a term which assumes a new significance in the light of our experiments. This is, so far as we are aware, the first information about the hitherto completely unknown function of the macula neglecta of the vertebrate labyrinth.

The vibration response of the elasmobranch labyrinth is, however, not confined to the pars inferior. The utriculus macula is only partly covered by its lime-encrusted otolith membrane. An uncovered portion of it, the lacinia, extends upwards to the roof of the recessus utriculi. We were able to isolate the nerve twigs supplying the lacinia and obtain single-fibre spike responses to vibrational stimuli, which did not materially differ in range and sensitivity from the saccular responses. In contrast to the immediately adjacent parts of the otolith-bearing utriculus macula, the lacinia does not respond to positional changes.

The experiments described above thus bring to a conclusion the point by point oscillographic analysis of the function of all known sensoria of the elasmobranch labyrinth on the basis of accurately localized single-fibre responses.

This summer's work was again carried out at the Laboratory of the Marine Biological Association at Plymouth with the aid of a Royal Society grant from the Parliamentary Grant-in-aid of Scientific Investigations, while one of us (O. L.) was privileged to hold the Physiological Society's Table at that Laboratory. Our special thanks are due to the director and staff of the Laboratory for their most generous support in providing the considerable amounts of living material and technical research facilities without which the work would have been impossible.

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Delayed Neutrons

IN his paper "Mechanism of Nuclear Fission", Bohr[1] has explained the emission of delayed neutrons from certain members of the fission chains as due to the product being in a sufficiently highly excited state after the emission of β-particles. Of the other possibilities, production of delayed neutrons by (γ,n) reaction by the γ-rays after a β-disintegration, following Bohr, can be excluded simply because of the absence of sufficiently energetic γ-rays in fission chains reported in the Plutonium Project Report[2].

There is, however, another type of reaction, namely, electro-disintegration or (e,n) reaction, the possibility of which for the emission of delayed neutrons cannot be ruled out. Recent experiments of such reactions on heavy elements by Skaggs *et al.*[3] have shown that these reactions have cross-sections less than those for photo-disintegration only by a few hundred times, and the reports[4,5] of photo- and electro-disintegration of Be^9 show definitely that their threshold energies are exactly equal. These facts lead to the conclusion that photo- and electro-disintegrations are sister reactions differing in their cross-sections only. As a matter of fact, we may infer that delayed neutrons would be ejected, by a process similar to electro-disintegration, spontaneously in the nucleus itself, by those particles of unusually high energy emitted by certain members of the fission chains, for example, Kr^{87} and Xe^{137}. As a result, though the neutron emission is instantaneous, they will be emitted throughout the half-life of β-emission analogous to the case of the γ-emission which, though instantaneous, yet follows the preceding β-life. This has been found actually to be the case for Kr^{87} and Xe^{137}, where neutrons follow the β-life. Our inference is that the high-energy electrons are responsible for ejection of neutrons from Kr^{87} and Xe^{137} by electro-disintegration.

Recently, workers[6] in the Berkeley Laboratory have detected a delayed neutron emitter in the low mass-number region by bombardment of the oxygen nucleus with 195 MeV. deuterons. According to them, N^{17} changes to O^{17} by emission of β-rays, and this O^{17} in its turn ejects delayed neutrons. But from the point of view of electro-disintegration, we may infer that it is N^{16} which emits β-rays of $\sim 6{\cdot}2$ MeV. and goes over to O^{16}. The remaining nuclei of N^{16} are undergoing electro-disintegration simultaneously by these high-energy β-particles, and become N^{15} by emission of delayed neutrons, so that N^{16} and not O^{17} is the delayed neutron emitter. This assignment of N^{16} fits in exactly with the scheme of disintegration found in the case of Kr^{87} and Xe^{137}, whereby the nuclei of the same element emit β-radiation and neutrons simultaneously.

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Reduction of Dead Times in Geiger–Müller Counters

THE significance of the positive ion sheath, formed in the immediate vicinity of the wire in a Geiger–Müller counter during a discharge, has been discussed by the Montgomeries[1] and by Stever[2]. According to them, the positive ion sheath is directly responsible for the dead time occurring in the counter after each discharge; the dead time is identified with the time necessary for the sheath to move sufficiently far from the wire for the field to be restored to a value at which the next event can be detected. Following this, Simpson[3] and Hodson[4] investigated the possibility of reducing the dead time by bringing the ion sheath back to the central wire and collecting it there. For this purpose they employed circuits by means of which the wire potential could be switched about 100 volts negative with respect to the cathode for a few microseconds after each discharge. Dead times as low as 20–30 microsec. were obtained in this way.

A consideration of this problem suggested that the major part of the reduction in dead time achieved was not due to positive ion collection but to the localization of the ion sheath, which is thus prevented from spreading along the whole of the wire, leaving the remainder of the counter sensitive to further ionizing events. This possibility is consistent with the known spread velocity of the ion sheath[5–7] and with the estimated operating speed of the circuit.

In order to confirm this suggestion, and to show that it is not necessary to reverse the wire potential and resort to ion collection to obtain shorter dead times, a circuit has been used to reduce the wire potential to within 20–30 volts of that of the cathode for about 1 microsec. after each count. Pulses from a counter operated in this way have been observed on a triggered cathode ray oscillograph, and dead times of 3–4 microsec. have been obtained, the limit being imposed by the recovery time of the electronic circuit. The dead times in this case refer to the counter as a whole; individual parts of the counter involved in any one count may be insensitive for much longer periods.

Further confirmation has been obtained in an experiment using a brass-walled counter, 38 cm. long

and 2 cm. in diameter, filled with 10 cm. pressure of argon and 1 cm. of alcohol. This counter was operated both with and without the switching circuit. Photo-multipliers (RCA 931 *A*), mounted opposite mica windows in the counter wall at each end of the tube, registered the counts occurring in these regions of the counter. A suitable counting-rate was obtained when beta-rays from P^{32} were passed into the counter, at right angles to the wire, through an aluminium window at one end.

	End near source (counts per min.)	End remote from source (counts per min.)
Normal operation	3614	3736
Counter operated with switching circuit	3526	42

The results quoted in the table are average values and have been corrected for the background. The first column gives the counting-rate registered by the photo-multiplier at the end of the counter near the source, while the second column shows the counting-rate at the other end. It is seen that when the circuit was operating, 99 per cent of the discharges did not reach the far end of the counter and were localized near the source end of the counter.

A similar experiment, performed with a collimated beam of gamma-rays and using a divided cathode counter, kindly lent by Dr. Craggs, has shown the same effect.

Circuits in which the wire voltage is reduced instead of being reversed have the great advantage that spurious counts are less likely to occur. This is so because, in the case of positive ion collection on the wire, there is a possibility of producing secondary electrons from the wire by the ionic bombardment[8] and subsequent formation of negative ions. An increase in the rate of spurious counts has indeed been observed when reversing circuits have been used under the same conditions.

Finally, it is suggested that the pulses from a photo-multiplier, used to detect the light produced during the formation of the ion sheath, might find applications where fast rise times are required. This possibility is being investigated.

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Crystal Structure of *d*-Tartaric Acid

We have been making a study of the crystal structure of *d*-tartaric acid by X-ray analysis. This is a classical substance which presents some little difficulty in complete analysis owing to its low symmetry and to the absence of a heavy or replaceable atom.

The unit cell dimensions obtained by us were in agreement with those reported by Astbury[1] and by Reis and Schneider[2], but the structure suggested by Astbury did not agree with our X-ray intensity data. We took sets of Weissenberg photographs about the three principal crystallographic axes, and calculated sections of the Patterson function at various *y*-levels. These sections enabled an approximate structure to be derived quite quickly. This structure gave fair intensity agreement of the (*hk*0), (*h*0*l*) and (0*kl*) planes, and permitted the evaluation of Fourier projections down the three axes. These projections are now being used to obtain more accurate values of the parameters.

A complete description of the structure is as follows: class, monoclinic sphenoidal; space group $P2_1$; cell dimensions, $a = 7{\cdot}73$, $b = 6{\cdot}05$, $c = 6{\cdot}18$ A., $\beta = 100°\ 17'$, containing two molecules $C_4H_6O_6$; parameters in hundredths of cell edges (apart from a possible inversion through the origin):

	x	*y*	*z*		*x*	*y*	*z*
O_1	35	0	51				
O_2	43	0	99	C_3	30	99	28
O_3	61	99	31	C_4	45	1	19
O_4	31	41	26	C_5	20	21	17
O_5	94	8	17	C_6	3	22	26
O_{10}	98	40	34				

The molecule has essentially the same configuration as in Rochelle salt[3], and neighbouring molecules are held together by a system of hydrogen bonds. The structure is still in need of refinement, and it is hoped to publish later more accurate values of the parameters, together with fuller details of the work summarized above.

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Intergranular Corrosion of Pure Aluminium in Relation to the Behaviour of Grain-Boundaries during Melting*

In two previous papers[1,2] we showed in the case of pure aluminium recrystallized by the 'critical deformation' method that the rate of etching of the grain boundaries by hydrochloric acid was more influenced by the relative orientations of adjoining crystals than by impurities in the metal itself. Thus the grain boundaries in two aluminium specimens of 99·99 and 99·998 per cent purity were corroded at the same rate in the case of crystals oriented at random, whereas the boundaries separating crystals of nearly identical relative orientations, or straight twin boundaries[3], were not corroded at all, regardless of the duration of etching and the concentration of the reagent. We have already reported a similar effect[3] when studying the micrographic etching of boundary lines in high-purity aluminium.

In order to compare the crystal boundaries obtained by recrystallization in the solid state with those obtained by solidification, we have been led to a careful study of the melting process itself. Chalmers[4] showed that the grain boundaries of high-purity tin had a melting temperature lower than that usually accepted for tin in the mass. We have now observed a similar effect in the case of high-purity aluminium by employing a simple device which was used by one of us[5] in the study of supercooled aluminium.

* Translation by Dr. N. Stuart.

A rectangular piece of metal, 1 mm. thick and 10 mm. × 130 mm. surface, was heated on a perfectly horizontal kaolin block inside a furnace permitting of a temperature gradient of 10° between the ends of the sample, so that one end may be molten while the other remains solid. If the metal is previously polished electrolytically, a zone may easily be observed (Fig. 1) as hollow lines where only grain boundaries are molten. The twin boundaries remain unaltered, however, thus giving evidence of a melting temperature nearly or quite equal to that of the crystals themselves (Fig. 2), and, as in the case of intergranular corrosion by hydrochloric acid, these also possess peculiar properties.

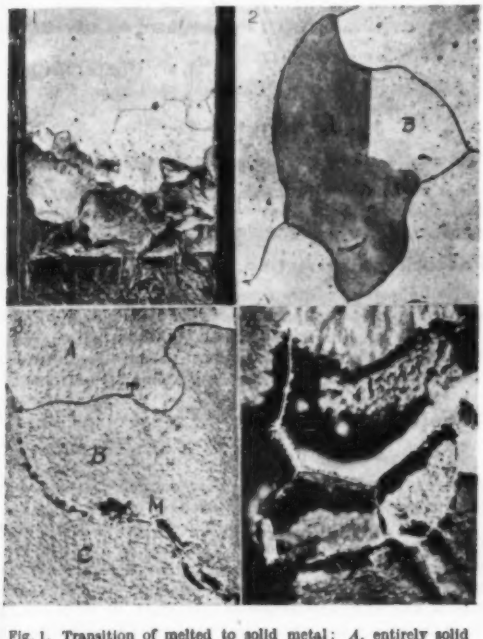

Fig. 1. Transition of melted to solid metal: *A*, entirely solid metal; *B*, boundaries only melted; *C*, partially melted crystals; *D*, entirely melted. (× 1)

Fig. 2. Unmelted twin boundary among melted ordinary boundaries. (× 5)

Fig. 3. Difference of intergranular corrosion between an unmelted boundary *T* and a melted boundary *M*. (× 5)

Fig. 4. Inverted corrosion by 30 per cent hydrochloric acid on pure aluminium heated for 15 hr. near the melting point. (× 5)

It might be thought that this characteristic behaviour of the boundaries during melting is related to their more or less disordered 'transition' structure, and that as a consequence of this their etching by hydrochloric acid would be different according to the relative orientations of adjacent crystals. Actually, as is shown in Fig. 3, the width of the intergranular groove due to etching in 30 per cent hydrochloric acid is very small and constant in the case of a sinuous twin boundary which had not been melted, whereas it is very large and irregular in the case of the molten boundary separating crystals of random orientation.

In conclusion, when the metal was heated for a long time (15 hr.) near the melting point, we observed, in certain cases, an inversion of the corrosion; for example, hydrochloric acid only dissolved the bulk of the crystals, leaving their boundaries uncorroded as a very thin surviving partition (Fig. 4). We intend to investigate how this inverted corrosion occurs.

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A New Carbide in Chromium Steels

In the course of X-ray investigations on the carbides formed in chromium and tungsten steels, a phase was encountered of a crystal structure identical with that of austenite, which at first it was thought to be. In fact, it proved to be a true carbide of iron and chromium. Its carbon content of 9·4 weight per cent carbon is similar to that in Cr_7C_3 (9·1 per cent C), compared with the maximum carbon solubility in austenite of only 1·7 per cent (at the eutectic in the iron–carbon system, chromium only decreasing this value). The carbides known in plain chromium steels since Westgren's[1] early researches are $(Cr,Fe)_{23}C_6$, $(Fe,Cr)_3C$ and $(Cr,Fe)_7C_3$, all of which, as well as the present one, I found it possible to produce in the same steel by different heat-treatments. The carbide is believed to be of interest for its own sake, but also for more fundamental reasons given below.

The structure, as in austenite, is face-centred cubic, with interstitial carbon to approach the NaCl type of lattice possessed, for example, by titanium, vanadium and niobium carbides. The cube edge is $a_0 = 3{\cdot}6111$ kX. $\pm$ 0·0002, but variations in Cr : Fe ratio, and in carbon content, and therefore spacing, are liable to occur, and the lattice is probably a defect one. The carbide is non-magnetic.

The compound is stable only at high temperatures, but by quenching the steel it can readily be retained at room temperature in a metastable state. On annealing at 1,000° C. or at lower temperatures, true trigonal $(Cr,Fe)_7C_3$ is formed. The carbide was obtained by electrolytic extraction from a 6 per cent chromium, 1 per cent carbon steel, quenched from 1,250° C., the resulting phase-constitution being:

Extract	Bulk steel (before extraction)	
'Austenite'—large amount. $(Cr,Fe)_7C_3$—small amount.	Martensite—large amount 'Austenite'—small amount.	(*A*)

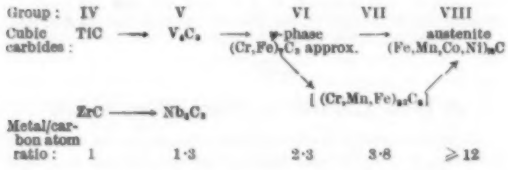
After a heat-treatment aimed at low-temperature equilibrium (anneal at 800° C., 3 hr., then 590° C., 3 hr.), the same steel showed, in contrast:

Extract	Bulk steel	
$(Cr,Fe)_7C_3$—almost pure Cementite—trace.	Ferrite—large amount. $(Cr,Fe)_7C_3$—medium amount	(*B*)

The carbon analysis of extract *A* gave 9·4 per cent carbon, of *B*, 8·7 per cent carbon, that is, both closely surround the Cr_7C_3 value of 9·1 per cent carbon. (The slight deficiency in *B*, if significant, falls into line with the presence of cementite, while the excess in *A* suggests a stoichiometric formula for

the cubic carbide, yet richer in carbon than Me_7C_3, such as Me_2C.) To differentiate the carbide from austenite it will here be referred to as 'ψ'.

From the point of view of structure chemistry, the present carbide may be shown to fall naturally into place. Petch[3] has shown that in austenite the carbon atoms occupy the octahedral positions; but, even for maximum saturation, only one among twelve of these sites is filled. On the other hand, within the group of carbides of NaCl type of structure, carbon atoms begin to be omitted from the ideal MeC lattice in a manner complementary to the austenite solid solutions, as becomes apparent when arranged according to the periodic table:


Group : IV V VI VII VIII
Cubic carbides : TiC → V4C3 → ψ-phase (Cr,Fe)7C3 approx. → austenite (Fe,Mn,Co,Ni)3C
[(Cr,Mn,Fe)23C6]
ZrC → Nb2C3
Metal/carbon atom ratio : 1 1·3 2·3 3·8 ⩾12

In this series, chromium and manganese occupy transitional positions; of their carbides, one simulates the cubic, one the hexagonal, and one the orthorhombic symmetry of those of the surrounding elements (V_4C_3, Mo_2C and Fe_3C respectively). But $(Cr,Mn,Fe)_{23}C_6$, though belonging to the cubic class, does not actually adopt the NaCl structure, having a complex unit cell with 116 atoms. The ψ-phase thus bridges a gap between austenite and the rock-salt type of carbides, being isomorphous to both and consistently falling into the above sequence of metal/carbon ratios. In this light, austenite may, incidentally, be itself regarded as a 'carbide', being the ultimate member of the cubic group.

The substitution in ψ of chromium by manganese, to give an analogue to ψ in plain manganese steels, is highly probable, though its existence has not, to my knowledge, been reported and may well in the past have been obscured by the predominant austenite.

The following implications of the ψ-carbide are suggested.

(1) Its existence imposes caution in interpreting an apparent austenite as such, when occurring in a ferrite or martensite matrix. Spacing measurements or the microscope will not necessarily decide between austenite and ψ. In high-speed steels, for example, the 'persistent' portion of retained austenite which only repeated tempering can destroy is quite liable to involve carbon-enriched ψ, or a solid solution of its type.

(2) The carbide can be produced in chromium-bearing tool or magnet steels, where, in view of its structure and composition, it would tend to induce physical properties compromising between a hard carbide and the more ductile austenite.

(3) Being stable only at high temperatures (though metastable at lower ones) and tending to transform into either trigonal $(Cr,Fe)_7C_3$, $(Cr,Fe)_{23}C_6$ or cementite, or assemblies thereof, the carbide holds promise of showing precipitation hardening effects, that is, by one carbide nucleating within another.

(4) Since the lattice dimensions are favourable to the formation of high-temperature solid solutions with austenite in chromium–nickel heat-resisting and stainless steels (but only for certain composition ranges), its tendency to segregate from the matrix and at the same time itself to decompose is likely to influence creep-resistance and high-temperature strength. X-ray analysis conducted in these laboratories on heat-resisting steels actually reveals sequences of ostensible 'austenites' of varying lattice parameter, some of which probably represent ψ-phases intermediate in composition to the austenite base and the co-existing close-packed cubic TiC type carbides.

(5) Prepared synthetically, ψ is a carbide of possible interest in sintered hard-metal materials, particularly being isomorphous with titanium carbide as well as with metallic cobalt and, on structural grounds, probably also intersoluble with tungsten carbide.

An account of the work on carbides in steels, of which this forms part, will be published elsewhere. I wish to thank Mr. D. A. Oliver, director of research, B.S.A. Group of Companies, for his interest and encouragement, and Mr. E. Harpham for the carbide extractions.

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Photochemical Action of Ethylorthoformate

Ciamician and Silber[1] showed that when an ethyl alcohol solution of benzophenone is exposed to sunlight, the alcohol is oxidized to aldehyde and the ketone reduced to benzpinacol; in the place of ethyl alcohol, *iso*propyl alcohol has frequently been used[2].

$$2\,Ph_2C:O + CHMe_2OH \xrightarrow{\text{sunlight}} Ph_2COH.COHPh_2 + Me_2CO.$$

A large number of benzophenone derivatives react in the presence of alcohols as above[3].

In a number of cases, pinacols have frequently been obtained from diaryl ketones, as by-products, when the ketones were treated with aromatic hydrocarbons, for example, toluene[4], or ether, *iso*-amylether, acetal and dimethylether of glycerol[5], or with esters, such as ethyl acetate, ethyl malonate[6], or acids, for example, phenylacetic acid[6]. The action of aliphatic alcohols on quinones, for example, *p*-benzoquinone in sunlight, yields hydroquinone[7]. Benzil, in absolute ethyl alcohol, forms benzilbenzoin[8].

Recently, I have found that on exposure to sunlight of benzophenone, *p,p'*-ditolylketone, *p,p'*-dimethoxybenzophenone and *p,p'*-dichlorobenzophenone with ethylorthoformate in sealed 'Pyrex'-glass tubes, the corresponding pinacols, namely, benzpinacol, 4 : 4′ : 4″ : 4‴-tetramethyl-, 4 : 4′ : 4″ : 4‴-tetramethoxy- and 4 : 4′ : 4″ : 4‴-tetrachlorobenzpinacol were obtained; deoxybenzoin gave a deoxybenzoinpinacol, whereas benzil yielded benzilbenzoin. On the other hand, the action of ethylorthoformate on *p*-benzoquinone, toluquinone, chloranil and phenanthraquinone, yielded hydroquinone, toluhydroquinone, tetrachlorohydroquinone and 9 : 10-dihydroxyphenanthrene respectively. Identification of the photo-products was carried out by melting point and mixed melting point determination with authentic specimens. In all these experiments, the fate of ethylorthoformate has not yet been investigated. Control experiments in the dark, but otherwise under identical conditions, showed no reaction.

The application of ethylorthoformate as a photochemical reducing agent in sunlight is still under investigation.

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[7] Comp. Klinger, *Ber.*, **19**, 1864 (1886). Ciamician and Silber, *Ber.*, **34**, 1530 (1901).
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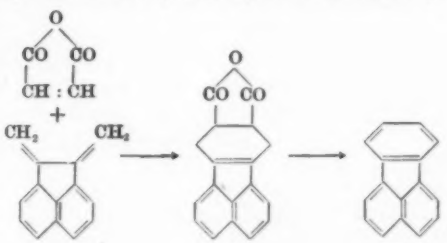
Fluoranthene Syntheses

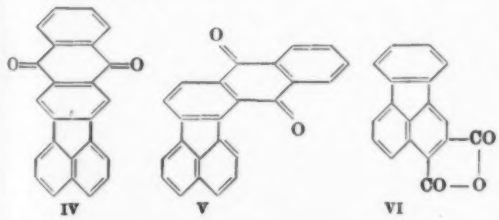
THE recent communication by Bergmann[1] on the formation of fluoranthene from acenaphthylene and butadiene prompts us to report briefly two somewhat similar syntheses of the hydrocarbon which have been developed in our laboratories.

trans-9 : 10-Dimethylacenaphthene-9 : 10-diol[2] when heated with acetic anhydride and maleic anhydride readily gives 10 : 11 : 12 : 13-tetrahydrofluoranthene-11 : 12-dicarboxylic acid anhydride (II), presumably by formation of the intermediate 9 : 10-dimethyleneacenaphthene (I)[3]. Dehydrogenation and decarboxylation of the product yield fluoranthene (III).



I II III

It is obvious that, by the use of substituted acenaphthenes or acenaphthenediols and replacement of the maleic anhydride by other ethylenic components, substituted fluoranthenes of known structure can be obtained. For example, substitution of maleic anhydride by α-naphthoquinone in the above reaction gives a quinone, melting point higher than 300°, which must have structure IV. The compound prepared by another method and regarded as having this structure[4] must be the isomeric quinone with formula V.



IV V VI

9-Methylfluorenol is known to undergo dehydration to the unstable 9-methylenefluorene[5]. By heating the carbinol with acetic anhydride and maleic anhydride, the intermediate methylene compound gives fluoranthene-3 : 4-dicarboxylic acid anhydride (VI), one of the nuclear double bonds being sufficiently reactive to participate in the Diels – Alder reaction. Decarboxylation gives fluoranthene (III). The reaction does not take place so readily as in the first method, but the structures of the products are unambiguously established.

Details of these and related experiments will be published elsewhere.

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Sulphur-containing Steroid Derivatives

PREVIOUS communications[1,2] have recorded the synthesis of antibacterial compounds derived from bile acids and sterols which contained basic groups, such as the amino-, amidino- and guanido-groups. In general, these derivatives were bacteriostatic for Gram-positive bacteria, but had little activity against Gram-negative organisms. Whereas surface tension measurements seemed to reveal a relationship between the bacteriostatic and surface activities of the bile acids and their anionic derivatives[3], no such relationship was apparent in the properties of a series of the basic steroid compounds[4]. In an extension of these studies, we have synthesized and investigated several water-soluble, sulphur-containing, steroid derivatives.

A series of mercaptals has been obtained by the condensation of thioglycollic acid with various keto-derivatives of steroids, a reaction which occurs without a catalyst and appears to be specific for a keto group at position 3. For example, 3 : 7 : 12-triketocholanic acid yielded 3 : 3-di-(carboxymethylmercapto)-7 : 12-diketocholanic acid, m.p. 203°, $[\alpha]_D^{24°}$ + 55·0°; (trimethyl ester : m.p. 78°, $[\alpha]_D^{17·5°}$ + 51·3°); 3-keto-7 : 12-dihydroxycholanic acid gave 3 : 3-di-(carboxymethylmercapto) - 7 : 12-dihydroxycholanic acid, m.p. 141°, $[\alpha]_D^{26°}$ + 35·7°; and Δ^4-cholesten-3-one afforded 3 : 3-di-(carboxymethylmercapto)-Δ^4-cholestene, m.p. 122–124°, $[\alpha]_D^{18°}$ + 108°. 3 : 3-Dithiophenyl-7 : 12-diketocholanic acid was derived from the condensation of thiophenol with 3 : 7 : 12-triketocholanic acid by a modification of the method of Mylius[5]. In a similar manner, 3 : 3-di(N-acetyl-*p*-aminothiophenyl)-7 : 12-diketocholanic acid : m.p. 165°, $[\alpha]_D^{18°}$ + 13·0°, was obtained by the condensation of N-acetyl-*p*-aminothiophenol with 3 : 7 : 12-triketocholanic acid. The monobasic, sulphur-containing acid, 3-carboxymethylmercapto-Δ^5-cholestene, m.p. 145°, $[\alpha]_D^{21°}$ – 34·2°, was obtained by the reaction of thiocholesterol with monochloroacetic acid.

Treatment of the sodio-derivative of thiocholesterol with methyl iodide afforded the methyl thioether, m.p. 141°, $[\alpha]_D^{18°}$ – 24·6°, which gave, upon further treatment with methyl iodide, Δ^5-cholestene-3-

dimethyl sulphonium iodide, m.p. 165°, $[\alpha]_D^{19°}$ − 27·7°. This basic derivative was water-soluble, and its antibacterial activity against *Staph. aureus* was among the highest yet reported for a steroid derivative. A more detailed account of these and related studies will be published elsewhere[6].

An indication of the bacteriostatic activity shown by the new compounds against *Staph. aureus* is shown by the data below. The figures in the second column refer to the limiting dilution bacteriostatic for *Staph. aureus*, tested for 24 hours at 37° C.

3 : 3-Di(carboxymethylmercapto) 7 : 12-dihydroxycholanic acid	1 : 4,000
3 : 3-Carboxymethylmercapto-Δ^4-cholestene	1 : 2,500
3 : 3-Di(N-acetyl-*p*-aminothiophenyl)-7 : 12-diketocholanic acid	1 : 10,000
Δ^5-Cholestene-3-dimethyl sulphonium iodide	1 : 20,000

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Construction of Troughs for Use in Chromatography Tanks

Previous workers[1-3] have described methods for the construction of troughs for use in chromatography. In this laboratory, a simple method of making troughs has been evolved which does not require any special apparatus or skill. The finished trough, owing to the uneven edge of the glass, does not require a glass rod or strip to hold the papers in place.

The materials required are 'Pyrex' or other similar glass tubing of the required bore (1–1½ in.), a gas-air blow-pipe and a 6-in. file with pointed tang. Any type of file or similar instrument will do, providing that the tang is about 2 in. long and the blade big enough to hold in the hand. The selected length of tubing is held securely on an asbestos-topped bench by an assistant. The operator warms about 4–6 in. of the end with a brush flame, and then, using a small intense flame, heats an area about ½ in. square until soft, at which stage the file tang is pushed in and the glass pulled out towards the operator. The flame is brought backwards about ½ in. and the above repeated until a slit 4–5 in. long has been produced: the ragged edges are now heated and smoothed back with the file, and the whole annealed with a brush flame. A further 4–5 in. is now done and the above repeated until a slot of the required length has been obtained. The ends of the tube are left open until the slot is finished, as this allows the flame to pass down and anneal the glass.

The trough is closed at each end by drawing out the tubing, and is adjusted in length by pressing the still hot ends on to an asbestos sheet. If a trough should fracture during manufacture or be accidentally broken, the pieces may be sealed at the ends and used in single-phase tanks. In this laboratory, two people, both unfamiliar with glass-blowing technique, can produce a 36-in. trough in half an hour.

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Origin of Fluctuating Galactic Noise

Since the discovery of discrete sources of radio-radiation in the Milky Way, special attention has been given to the rapid fluctuations shown by some of these. It seemed possible that these could be of the same kind as the 'bursts', occurring in the solar radiation of radio-frequency.

Ryle and Smith, studying the source in Cassiopeia at 80 Mc./s., made the very interesting observation that the variable component is probably not circularly polarized, and they therefore conclude that its origin must be different from that occurring near sunspots[1].

I should like to point out that at least three components of the solar radio-radiation should be distinguished: (1) the radiation of the quiet sun; (2) the radiation of the disturbed sun, varying only slowly and depending on the number of spots; (3) the bursts. Component (2) shows circular polarization; *but the bursts do not.* This seems to be well established by the observations of Payne-Scott, Yabsley and Bolton[2], at frequencies of 60 and 100 Mc./s.

Even if their result should not be general, it is clear that the random polarization of the fluctuation in Cassiopeia gives no evidence against an origin similar to that of the solar bursts. It therefore remains possible that these fluctuations are produced in individual stars. That they could be analogous to the disturbed solar radiation was already very improbable owing to the rapidity of the fluctuations, and is entirely disproved now.

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[2] Payne-Scott, Yabsley and Bolton, *Nature*, **160**, 257 (1947).

Prof. Minnaert has pointed out the distinction between the three components of solar radiation. We would like to make it clear that the primary object of the experiment described in our previous communication[1] was to investigate the origin of the *steady* component of the radiation from the two intense galactic sources. The results which we obtained suggested that the steady component is produced by a mechanism similar to that of the 'thermal' radiation of the quiet sun.

The additional evidence, that the variable component appears to be unpolarized, has suggested to Prof. Minnaert that this component is analogous to solar 'outbursts'. We would agree that such a mechanism may be responsible, although we do not feel satisfied that there is sufficient evidence for the conclusion that solar 'outbursts' are unpolarized.

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[1] Ryle and Smith, *Nature*, **162**, 462 (1948).

A TRAVELLING-WAVE LINEAR ACCELERATOR FOR 4-MeV. ELECTRONS

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THE basic principles of this type of accelerator and the details of a first model producing 0·5-MeV. electrons have already been described in *Nature*[1]. The accelerator here described follows the same general design, and as the phase velocity approaches the velocity of light the ratio of the inner radius of the corrugated guide to the air wavelength tends towards the same limit, namely, 0·2. The length has been increased to two metres with a radio-frequency power of 2·0 megawatts so as to accelerate electrons to the region of 4 MeV.

The corrugated wave-guide was designed to accept 45-keV. electrons from the gun and to bunch them about a stable phase position 45° in front of the point of maximum accelerating field, when the radio-frequency power is 2·0 MW. In the first 40 cm. of guide, the phase velocity was designed to be greater than the velocity of the stable electron, and such that the centre of the bunch moves from 45° to 35° as the phase oscillations die away. The accelerating field experienced by the stable electron increases from 17·5 kV./cm. to 20·5 kV./cm. (the peak field being 25 kV./cm. for 2·0 MW. of radio-frequency power). At 40 cm. the phase velocity was reduced to that of the stable electron and the phase angle maintained at 35° for the remainder of the two metres[2]. The measured phase error for the full two metres of corrugated wave-guide was found to be only 18° in 22 wave-lengths. The overall loss, including the improved form of feeds from rectangular to corrugated wave-guide, was 2·5 db.—hence the accelerator is still short of the efficient length[3,4].

The completed equipment, Figs. 1 and 2, resembles the first accelerator and has, in addition, a mismatch unit and phase shifter in the input rectangular wave-guide in order to pull the magnetron frequency, and an arrangement for automatically sweeping the magnetic field of the spectrometer in order to present a spectrum of output current versus energy directly on a cathode ray tube with a long afterglow.

The accelerator was first operated in February 1948. X-ray output was obtained immediately, at an energy between 3 and 5 MeV. (from lead absorption measurements). The energy was confirmed as being 4 MeV. with a simple form of spectrometer. The pulse of 4-MeV. electrons observed through the spectrometer was extremely narrow for low radio-frequency powers and was confined to the beginning of the 2-microsec. radio-frequency pulse. For larger radio-frequency powers the remainder of the pulse appeared at a somewhat lower energy. A small output was also obtained at about 1 MeV., the precise quantity and energy varying greatly with the general setting of the various controls and in particular the currents in the focusing coils. Under normal optimum conditions for 4 MeV., the 1-MeV. output was only a few per cent of the total.

Great difficulty was experienced in trying to measure directly the electron currents falling on the first collimating slit of the spectrometer, due to the large quantities of gas liberated by the radio-frequency power with the accompanying ionization effects. The beam was therefore allowed to pass into air through a copper window 0·005 in. in thickness (later replaced by the same thickness of aluminium). A lead target $\frac{1}{4}$ in. thick was then used and a maximum X-ray yield of 3 roentgens per minute at a metre was obtained (this being limited by the maximum safe emission from the 0·2-mm. tungsten filament then in use). According to conversion figures then available, the mean current at 4 MeV. was computed as $\frac{3}{4}$ microamp. A direct measurement of the electron current falling on the lead target gave the considerably larger result of 3 microamp. The radio-frequency duty cycle was 1 part in 10,000 throughout (2-microsec. pulses—50 c./s.), giving a peak current of 7·5 milliamp. for a mean current of $\frac{3}{4}$ microamp. For a mean input power of 200 watts (2-MW. peak) the energy in the 4-MeV. beam was of the order of 3 watts; this was considered to constitute no appreciable loading during the measurements taken with the automatic spectrometer.

Since there was evidence that the beam was somewhat off the axis of the corrugated guide, the beam position and size were investigated with a fluorescent screen (willemite on mica) and a periscope system. The effect of the various focusing devices was readily

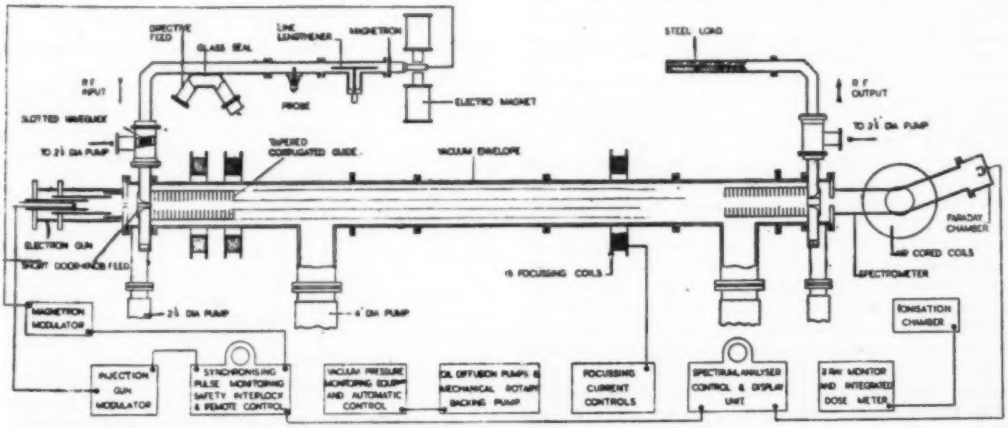

Fig. 1. Schematic diagram of 4·0-MeV. linear accelerator

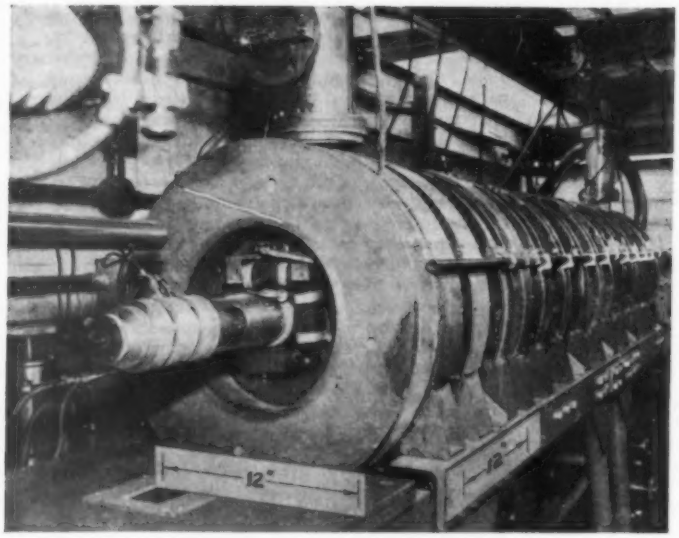

Fig. 2. Photograph of 4·0-MeV. linear accelerator, from gun end

observable. Under optimum conditions the spot size was certainly less than 1 cm. in diameter and probably of the order of 7 mm. No visible change occurred when a 2-mm. aluminium filter for 1-MeV. electrons was inserted. The spot was certainly off centre and could not be moved by varying the angle of injection of the 45-keV. electrons from the gun. Correction was eventually made with a small vertical magnetic field about 50 cm. down the accelerator.

A systematic investigation was then carried out using the automatic spectrometer for varying radio-frequency powers over a considerable range of radio-frequencies. A few energy spectra (Figs. 3 and 4) are given to illustrate the various phenomena observed. At the same time, X-ray measurements were taken as a rough indication of the number of accelerated electrons.

The design frequency was chosen to be 2997·8 Mc./s. ($\lambda = 10{\cdot}00$ cm.). Allowing for the measured phase discrepancy in the corrugated guide, the working frequency should be 2998·1 Mc./s. At the lower frequencies the stable phase position should move towards the peak of the wave as the electrons move along the accelerator, and eventually when the peak is reached there will be no stable position. This was observed to happen around 2995·5 Mc./s.—there being a very small output with an energy in the region of 3·6 MeV. for a frequency of 2995·6 Mc./s. At 2996·6 Mc./s. the spectrum was observable for a radio-frequency power equal to or greater than 1·9 MW. At 1·9 MW. (Fig. 3*a*) the spectrum had two distinct lobes which occurred at widely different energies. The output pulse, viewed on a time instead of an energy scale, consisted of a short spike (about ½ microsec.) occurring at the front of the 2-microsec. pulse, and then the remainder of the pulse was not seriously broken up. This spike always provided the higher-energy component. As the radio-frequency power was increased, the total output current invariably rose and the spike or higher-energy component was drastically reduced. The presence of the spike is not understood, and it cannot be correlated with the frequency-time spectrum of the radio-frequency pulse, since it occurred for any radio-frequency spectrum provided that radio-frequency power and frequency were sufficiently low. In some cases it was interesting to note that the relative amplitudes of the higher- and lower-energy lobes could be altered considerably by varying the amount of external focusing. As the frequency was increased, the high-energy spike became almost unobservable except at the very lowest radio-frequency powers, and at 2998–2999 Mc./s. the width of the spectrum between half-amplitude points could be reduced to the order of 0·3 MeV. (Fig. 3*b*). It was suspected that some of this width was still due, however, to time modulation during the 2-microsec. pulse. At still higher frequencies the high-energy spike appeared again at the higher radio-frequency powers, together with a general broadening of the half-amplitude width.

The variation of energy of the spectrum peak with frequency for 2·0 MW. of radio-frequency power is shown in Fig. 4. It is evident that the accelerator functions in a satisfactory manner over a range of about 3 Mc./s. and is generally at its best at approximately 2998 Mc./s.

Having chosen a satisfactory working frequency (2998·8 Mc./s.) with 2·25 MW. of radio-frequency power, the effect of varying the gun voltage was investigated. There was a distinct threshold at 17·5 kV. and a steady rise in current output from this point upwards. The energy of the peak in the spectrum was about 4·5 MeV. at the threshold and

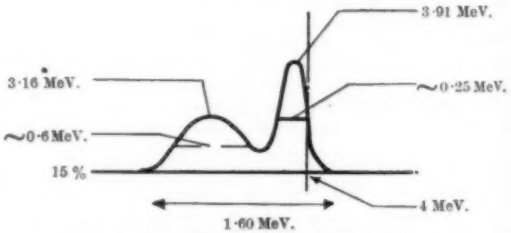

Fig. 3*a*. Radio-frequency 2996·6 Mc./s.; radio-frequency power, 1·9 MW.; ion chamber, 0·18 (full scale, 1·0)

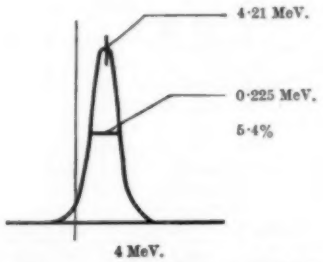

Fig. 3*b*. Radio-frequency, 2998·2 Mc./s.; radio-frequency power, 2·2 MW.; ion chamber, 0·36

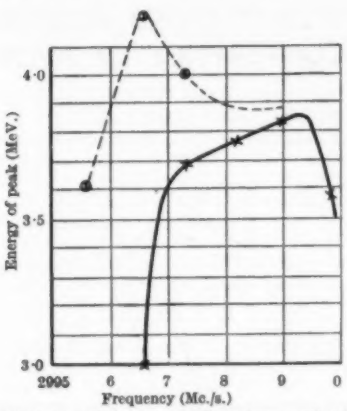

Fig. 4. Variation of the energy of spectrum peak with R.F. frequency. ⊕, high E spike

fell steadily to 3·85 MeV. at a gun voltage of 45 kV. The half-amplitude width of the spectrum increased rapidly, being 0·27 MeV. at 30 kV. and 0·42 MeV. at 40 kV. This behaviour was identical with that of the shorter 0·5-MeV. accelerator and can be explained in precisely the same manner. It was significant, however, that with the longer length of guide the energy variation was not so pronounced, although even in this case electrons at low injection voltages being picked up near the peak of the wave were still moving relatively slowly down to the true stable phase position.

Using the optimum conditions so far determined, and increasing the injected current by increasing the gun filament from 0·2 mm. tungsten to 0·3 and then 0·4 mm., the X-ray yield using a lead target $\frac{1}{8}$ in. thick (and a 2-mm. lead filter for soft radiation) has been increased to 30 roentgens per minute at a metre at 50 c./s. recurrence-rate. By increasing the recurrence-rate the output has been scaled up to 66 r./min. at 100 c./s. and 132 r./min. at 200 c./s. The maximum permissible recurrence-rate, determined by the magnetron, is 500 c./s., giving a potential X-ray yield of 300 r./min. The output reached a maximum with the 0·4-mm. tungsten current at 12·6 amp., and no further increase could be obtained by going up to 14·0 amp., which should represent an enormous increase in emission. It was evident from the fact that at 30 r./min. a hole was very soon burnt through the lead target (and at 132 r./min., even with a strong blast of air on the bombarded side, burn-out was quite common) that the mean power in the beam was quite large and easily measurable by calorimetry. (It is interesting to note that the hole burned in the target was invariably about 7 mm. in diameter.) A continuous-flow water calorimeter was therefore constructed consisting of a lead target $\frac{1}{8}$ in. thick with a circulating water film 7 mm. in thickness on the bombarded side. A small spiral heater of diameter comparable with that of the beam was mounted in the water near the target spot on the lead. Direct comparisons could then be made of beam power and power required in the heater to produce the same temperature difference between inflow and outflow as indicated by a thermocouple system. In this way it was established that the mean power in the beam at 50 c./s. under conditions which gave an X-ray yield of 30 r./min. was almost exactly 60 watts, giving a mean current of 15 microamp. and a peak current of 150 milliamp. if the energy was taken to be 4 MeV. Hence the highest current which has so far been obtained is 60 microamp. with a possible maximum of 150 microamp. at 500 c./s., the highest magnetron recurrence-rate. The efficiency in terms of radio-frequency power being fed into the accelerator is 30 per cent, and since the radio-frequency losses in the system are normally 2·5 db., it is understandable that no further increase in efficiency is readily obtainable. It has also been observed, using the spectrometer again, that the width of the spectrum is generally unaffected by increased beam current, but the energy of the peak falls by about 250 keV.

Acknowledgment is made to the assistance given to this project by our colleagues. This work was carried out by the Electronics Group of the Atomic Energy Research Establishment, at the Telecommunications Research Establishment, Malvern, and acknowledgment is made to Sir John Cockcroft for permission to publish these results.

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[2] Walkinshaw, W., *Proc. Phys. Soc.*, **61** (Sept. 1948).
[3] Mullett, L. B., and Loach, B. G., *Proc. Phys. Soc.*, **61** (Sept. 1948).
[4] R.-S.-Harvie, R. B., *Proc. Phys. Soc.*, **61** (Sept. 1948).

SOUTH AFRICAN MUSEUMS

THE appointment of a commission to investigate and report upon the future policy of certain State-aided institutions in South Africa is the subject of an announcement by the Department of Education in the *Government Gazette* (*Pretoria*) of October 8, 1948. It is understood that State-aided institutions include museums, art galleries and zoological gardens. The members of the commission are Dr. P. J. du Toit (chairman), Dr. G. von Welflingh Eybers, Prof. J. J. Smith, Dr. S. H. Haughton and Dr. S. H. Skaife.

This announcement will be welcomed by South African museum directors generally, but it seems a pity that the scheme could not have been extended to embrace all museums in the Union, for all are faced with similar problems affecting adequate housing accommodation, up-to-date equipment, and staffs trained in modern museum methods and technique. Nevertheless, the present action is a step in the right direction, for the Government has now taken a lead which ultimately may influence all provincial and municipal museums, irrespective of whether they do or do not receive a Government grant.

Generally speaking, there is at the present time a considerable amount of room for the improvement of South African museums in relation to their appeal and use to the general public. Although in one or two of the larger institutions exhibition rooms have been improved by the introduction of the animal habitat group, dioramic backgrounds, and models, etc., museum exhibition in the Union on the whole lacks imaginative construction. In many cases the presentation of collections is along old and stereotyped lines; labelling is often poor and inadequate for purposes of sufficient instruction; related subjects are badly linked—or not linked at all; while some are so scantily treated as to be of little or no value in the museum concerned. Again, the special temporary exhibition of current or topical interest seems to find no place in South African museum

administration; and lectures, informal talks, or classes upon subjects of particular interest in the museum do not seem to be a regular, or even frequent, feature of the work of the officials. Introductory series, so useful where the uninitiated and schools are concerned, are usually absent; and very rarely indeed, if at all, are collections used to illustrate or teach such matters as, say, the impact of geology upon the mining and building industries, upon road and railway construction, or upon water-supply, etc.; or again, the impact of biology upon medical and veterinary research, upon agriculture, horticulture, and matters of human health, and so on. The average archæological collection (and most South African museums are rich in this material) neither tells the 'story' of prehistoric man in South Africa nor illustrates archæological method. A great deal more, also, could be effected with the usually abundant collections of native material—in the more graphic portrayal of tribal customs, mode of life and social organisation, for example. The brilliant exhibit of life-like models of Bushmen (both male and female) in the South African Museum at Cape Town well illustrates the possibilities in this direction. These figures, set up in astonishingly realistic attitudes, wear Bushman clothing and carry Bushman weapons of the chase or war, and associated with them are Bushman domestic utensils. Cast from life, these 'living' records of a practically extinct people make the Cape Town Museum unique among all others in the Union.

With few exceptions, the congestion of the average South African museum exhibition-case leaves no room for the treatment of subjects in some of the ways suggested; but considerable improvement would be possible (even without building extensions) if a good half of some of the material exhibited were to be transferred behind the scenes—not to be lost or neglected, but to be suitably and systematically stored for the better use of the student and specialist worker. Several museums, in this way, could make room for better exhibition work in the public galleries.

Other matters which strike one as requiring consideration in the museums of the Union are appointments and retiring ages. At the present time some appointments seem to go to individuals who have already retired from some other walk of life. In the case of directorships or curatorships, especially, it is important that appointments should go to those who have had training and wide experience in museum work and methods, and who can put in a sufficient number of years of service before reaching retiring age.* As yet, there seems to be no hard and fast rule as to the age at which a museum official should retire. It is clear, however, that this should be fixed in the interests of any progressive policy of work and service. New ministerial blood at prescribed intervals is a necessity to any institution the primary function of which is public service—and service suitable to the times.

There is, no doubt, a big future for South African museums; in a rapidly developing country they are a cultural necessity. South African museums have already carried out much useful work in scientific research, and vast fields for further study and collection lie before them. As has already been suggested, however, there is room for better work in their educational function, the function which, in the long run, will determine not only their use to the community, but, in addition, their status within it.

J. R. HARDING

TWENTY-THIRD ANNUAL CONFERENCE OF ASLIB

DURING September 17–20, the twenty-third annual conference of Aslib was held at Ashorne Hill, near Leamington Spa. This Conference resumed, for the first time since 1938, Aslib's residential conferences, which, with the fast-expanding number of special librarians and information officers, are essential if the old and experienced members are to mix informally and discuss the difficulties of the younger and comparatively inexperienced information officers. Some idea of the extent to which this is necessary is given by the growth of Aslib's membership: 1,010 on June 30, 1948; 827 in 1947; and 712 in 1946. At the beginning of the War it was less than 300. Of the total, research associations and learned societies account for 33 per cent, industrial and commercial organisations 20 per cent, individuals 22 per cent, overseas members 17 per cent, and British Government Departments 8 per cent. These figures give some idea of the extent to which the information officer and special librarian have become essential members of any well-conducted, modern research establishment and progressive industrial concern.

The report by the director (Miss E. M. R. Ditmas) of the work of Aslib, 1947–48, pointed out that 'Aslib' is now a registered name, and since the amalgamation with the British Society for International Bibliography on January 1, 1948, no longer stands for "Association of Special Libraries and Information Bureaux". The amalgamation added a couple of score of members. The increased amount of work means that a series of afternoon meetings will be held between October 1948 and April 1949, besides the annual conference. Instead, therefore, of an annual publication of *Conference Proceedings*, there will be a new journal, *Aslib Proceedings*.

In March 1948 Aslib called the meeting which is now working towards an Institute of Recorded Sound; sixty students attended the Aslib Study Group in August 1947, and seventy in April 1948, and a memorandum on "Training of Information Officers" was drawn up by a Sub-Committee of the Education Committee; the Information and Library Section recorded 2,521 inquiries, had 66 requests for registered translators and supplied 2,275 items through the Documentary Reproduction Service. The Aslib library receives regularly more than 100 periodicals; but lack of suitable premises makes 52 Bloomsbury Street badly overcrowded. At the request of the Department of Scientific and Industrial Research, Aslib set up, in June 1947, its Committee on the Mechanized Distribution of Information to discuss the uses of mechanization in library and technical information work, and supplied a statement to the Royal Society's Conference. In December 1947 the Committee on the Format and Efficiency of Periodicals was set up.

Naturally, Aslib has taken much part in the documentation work of the British Standards Institution, the British National Committee on Documentation and many international and foreign organisations. Sir Richard Gregory was made an honorary member during the year.

Usually the annual conference of Aslib is organised almost as a symposium of papers on one or, perhaps, two subjects of universal interest. This year it was a miscellaneous collection dealing rather more with the existing problems in the fields of the information

officer and special librarian than with the uttering of any startling ideas or announcements.

Saturday morning, September 18, opened with Dr. R. E. Priestley (vice-chancellor and principal of the University of Birmingham) in the chair. Mr. B. Fullman (British Non-Ferrous Research Association, chairman Aslib Education Committee) opened the proceedings on "The Training of the Information Officer", basing his arguments on a statement which had been circulated confidentially to Aslib members. "Information officers," he said, "are fashionable and no home is complete without them, and they are budgeted for as a matter of course." He urged that Aslib should consider issuing a diploma to ensure that organisations would, in the future, obtain properly qualified people. He emphasized how diverse, yet specialized, is the information officer's work compared with that of the librarian as normally considered. He endorsed a flexible arrangement with the Library Association, but emphasized that the scientific world needs information officers and special librarians who have first obtained a science degree.

Mr. J. S. P. Paton (Metropolitan-Vickers) discussed the questionable necessity for the prospective information officer to have to take the whole of the Library Association's course. He pointed out the need for such special requirements as languages, the ability to speak the language of scientific colleagues and for the necessity for good practical experience of research departments.

Mr. F. G. B. Hutchings (Leeds City librarian and chairman of the Education Committee, Library Association) endeavoured to minimize the difference between librarians and special librarians and information officers by emphasizing the amount of inquiry in public libraries and their closer association with local industrial and scientific organisations. He said that the new Library Association syllabus is "getting to be bibliographical rather than literary". Therefore, why a special Aslib diploma and course ?

The lively discussion from the floor emphasized that the industrial and research intelligence officer makes use of information besides collecting and collating, the necessity for the initial scientific training and the fact that ability in this field cannot always be assessed by examination, but is a natural aptitude. It resulted in the whole matter being referred back to the Aslib Council for further consideration after this preliminary airing of many views.

The Saturday afternoon session, under Dr. E. Marsden (New Zealand Scientific Liaison Office, London), was devoted to Prof. J. D. Bernal talking on "The Significance to Special Librarians and Information Officers of the Royal Society's Scientific Information Conference". He opened by stating, "it depends upon Aslib and Aslib members as to whether the resolutions of the Royal Society are implemented". He referred to Dr. D. J. Urquhart's "Survey of Scientific Reading Habits" and gave in some detail the figures and conclusions given in his own paper, "Preliminary Analysis of Pilot Questionnaire on the Use of Scientific Literature" at the Society's Conference. He raised again the necessity for reprints, or 'separates', and the necessity for the relinquishing of copyright by authors of papers, so that they may be freely reproduced from journals. He asked, "Is the liaison between user and the information officer sufficient ?" He mentioned the non-co-ordination between the libraries of scientific institutions in the Bloomsbury area, and how co-ordination had been achieved in his own subject of physics.

Mr. J. E. Cummins (Australian Scientific Research Liaison Office) sketched the library position in Australia, stressing the need for the librarian there to cease "to look upon himself as a keeper of books". Dr. S. R. Ranganathan (president of the Indian Library Association) said that "work in the library world is going on in a casual way without any planning", and called for a special study of 'librometry'. The need for proper co-ordination of abstracting and suggestions that abstracts be available before or as soon as a paper is ready to be read, and not after the now delayed publication, was mentioned in the discussion, in which a large number partook. It emphasized the difficulties and problems of getting the right information to the right person at the right time. The increasing need for this over the years was clearly recognized when Aslib was founded twenty-four years ago to start creating order out of confusion and to be the prime mover ever since.

Sunday morning, under the chairmanship of Mr. J. F. Stanley (British Standards Institution), opened with Mr. Eric Smythe (librarian and research officer of *Reynolds News*) discussing the organisation and working of a newspaper's press-cutting library and the mechanics of storage. He emphasized the speed and efficiency with which such a library should work, and that facts are wanted sometimes on immediate notice five minutes before going to press.

Sir Cuthbert Whitaker, in his fifty-fourth year of editorship of *Whitaker's Almanack*, gave a straightforward account of the "History and Compilation of *Whitaker's Almanack*". He mentioned how his father, the late Joseph Whitaker, while pacing up and down a garden path, in 1868, remembered the "Commonplace Book" he had compiled when conducting the correspondence columns of the *Gentleman's Magazine*. He thought its publication in an organised form, together with meteorological data, which Sir George Airey was delighted to supply, thus justifying the term 'almanack', would be welcomed by the public.

The first *Almanack* for 1869 appeared on December 10, 1868, and had 363 pages and an index of 1,100 entries. The 1948 edition has 1,092 pages and 35,000 references. The plan of the *Almanack* was so carefully designed by Joseph Whitaker that the main part of the work ever since has been "submitting proofs and reducing the exuberance of corrections".

With Dr. J. C. Withers (Shirley Institute) as chairman, Dr. Hugh Clegg (editor of the *British Medical Journal*) and Mr. R. Brightman (Imperial Chemical Industries, Ltd.) talked on "The Art and Technique of Book Reviewing". They both emphasized the importance of a review of a scientific or technical book giving "a clear account of what the book is about, indicating both the scope of the book, the scale on which the subject is treated, and the particular type of reader for whom it is intended". Dr. Clegg strongly advocated that all authoritative book reviews should be signed by the reviewer.

Sunday evening was devoted to a discussion on "Practical Applications of International Collaboration in Documentation", opened by Mr. E. J. Carter (head of the Library Section, Unesco), who said, "It is becoming clearer that documentation and library services are the very roots of international collaboration". It was essential to bring practical people together to collaborate and surmount language difficulties to give complete and efficient transmission of ideas. This means a properly organised and ade-

quate secretariat. "Delegates to international conferences must have documents beforehand in their own language to be able to discuss them with their own people." This was strongly supported by Dr. Ranganathan, who pointed out that many conferences fail because of quite inadequate preliminary documentation. He also advocated that older delegates to conferences should be accompanied by a younger man, who would thus be properly experienced when it became his turn to lead. He emphasized how adequate documentation overcame language difficulties, while the use of a universal classification system, such as the U.D.C., prevented misunderstanding as to the precise definition of a subject. Dr. P. Bourgeois (director, Swiss National Library) pointed out that this was not generally being done, and instanced some recent international conferences, which had achieved little because of the paucity of their practical application of documentation.

Mr. A. B. Agard Evans (Ministry of Works Library) said that there were far too many international resolutions, and not enough practical activity. This was due, in some instances, to the lack of national collaboration first, and he directed attention to the fact that the building industry was one of the wealthiest in the world, yet it had little international collaboration.

In association with the conference, Aslib arranged an exhibition of representative bibliographies and abstracting journals. IVOR B. N. EVANS

INDIAN DAIRY SCIENCE

THE immense importance of a substantial increase in production and consumption of milk and milk products, both to the balance of Indian agriculture and in contributing protein, fat and minerals to the very largely cereal diet of the 320 ± 20 million inhabitants of present-day India is being increasingly appreciated in that country. For perhaps two decades, real efforts have been made to improve the dairy industry in India both as regards milk production (in which Mahatma Gandhi took a personal interest) and as regards milk distribution and manufacture. Progress, hindered by religious as well as economic obstacles, has, however, been rather disappointing.

This slow development has also been due, in no small part, to other causes—paucity of knowledge, the serious shortage of trained dairy husbandrymen and of satisfying opportunities for their activity, the acute lack of dairy scientists, technologists and engineers and the absence of more than a small handful of research workers in dairying. Research is clearly needed in two directions: first, the application to the severer climatic and other conditions of India of the knowledge already applied in the more progressive dairying countries in the temperate zones; and secondly, basic study of the nutrition, breeding and physiology of dairy stock in India and of the microbiology, biochemistry and engineering underlying modern dairying operations.

The recent formation of an Indian Dairy Science Association with similar objects to those of the Society of Dairy Technology in Great Britain, namely, the advancement of dairy science, the provision of opportunities for the exchange of knowledge and ideas, and the encouragement of scientific inquiry into problems arising in the industry, is a step in the right direction. The Association is fortunate in having Sir Datar Singh, the energetic chairman of the Indian Council of Agricultural Research, as its first president. The Association has just issued the first number of a new journal, the *Indian Journal of Dairy Science*, which is to appear quarterly under the editorship of the director of the Indian Dairy Research Institute at Bangalore, Dr. K. C. Sen (Indian Dairy Science Association, Hosur Road, Bangalore, India. 12 rupees per annum).

The present number contains six original articles dealing with aspects of milk production, control of milk keeping quality, milk composition, milk phosphatase, vegetable rennet and indigenous butter. While it would be unfair to apply too critical an eye to some of these early contributions, they are all of value, and one at least, by Krishnamurti and Subrahmanyan, is outstanding. A promising start has been made, and several in Britain who know at first hand of the immense difficulties which have still to be overcome before the mutually dependent partners, dairy science and the dairying industry, can flourish in India, will look forward with great interest to the future progress of this *Journal*.

H. D. KAY

FOREST POLICY IN UGANDA

A STATEMENT on the forest policy for Uganda was recently issued by His Excellency the Governor and published as a Supplement to the *Uganda Gazette* of June 15, 1948.

This statement is of interest as it is promulgated by the Governor himself. The main points are as follows: 1. (i) To reserve in perpetuity, for the benefit of the present inhabitants of Uganda and of posterity, sufficient land (either already forested or capable of afforestation) to maintain climatic conditions suitable for agriculture, to preserve water supplies, to provide forest produce for agricultural, industrial and domestic purposes, and to maintain soil stability in areas where the land is liable to deterioration if put to other uses. (ii) To manage this forest estate to obtain the best returns on its capital value and the expenses of management, in so far as such returns are consistent with the primary aims set out above. (iii) To foster, by education and propaganda, a real understanding among the people of Uganda of the value of forests to them and their descendants. (iv) To encourage and assist the practice of sound forestry by local authorities and private enterprise; and to educate selected Africans in technical forestry.

It is of interest to note that these points in forest policy were first laid down by the Secretary of State for India in London as far back as 1862. They have since been repeated by many governments in many parts of the world, but only rarely have been given practical effect.

The Governor continues: 2. To achieve the first objective of this four-point policy, namely, the creation of an adequate forest estate, the following guiding principles shall be observed: (i) The climatic and physical conditions of the country must be preserved and, if possible, bettered, by first, the reservation of suitable land, and secondly, the maintenance, improvement or re-establishment of vegetation on the most important catchment areas and on other strategic positions. (ii) The supply in perpetuity of the many forms of forest produce required

to satisfy the wants of the people of Uganda both now and in the future must be assured by the reservation, preservation, development and management of the minimum area of forest land needed for this purpose.

3. It is accepted that the satisfaction of the needs of the inhabitants of Uganda must take precedence over purely financial considerations and the establishment of an export trade; and that only when these needs have been satisfied can the aim of management be directed, in production reserves, to obtaining the greatest revenue compatible with a continuous yield, and to promoting an external trade in timber and other forest produce.

The statement lays down some general conditions for the implementation of forest policy and the immediate steps to be taken to implement it. In the last paragraph it is said that in the opinion of the Government the primary tasks of the Forest Department during this decade must be to complete the formation of the forest estate.

The Governor may be congratulated on having formulated in his statement a true outline of what forest management plans for. In the first thirty years after the formation of the Indian Forestry Department in 1864, the formation of the forest estate had to a great extent been completed, it having been laid down that this was the first object to be attained. It is a pity that so many of the colonial forestry services did not undertake this indispensable work during the early years of their embodiment.

INSTITUTION OF CIVIL ENGINEERS

AWARDS

THE following awards have been announced by the Council of the Institution of Civil Engineers for the session 1947–48:

James Alfred Ewing Medal for 1947: Sir John Cockcroft (see *Nature*, April 17, p. 592).

Telford Premiums: B. D. Richards, for his paper on "Tidal Power: its Development and Utilization"; R. W. S. Thompson, for his paper on "The Reconstruction of Bamford Filters"; W. J. O. Scott, for his paper on "Roads and their Riding Qualities"; B. F. J. Bradbeer and Prof. C. A. Hart, jointly for their paper on "Photographic Surveying in Relation to Road Engineering in Highly-developed Countries"; C. V. Blumfield, for his paper on "The Development and Use of Barrel Vault Shell Concrete"; E. A. G. Johnson, for his paper on "Flooding in the Fens and Remedial Measures Taken"; W. R. Greathead and R. D. Hawkins, jointly for their paper on "First Stages in the Construction of the Jan Smuts Airport, Johannesburg"; Dr. S. L. Bey, for his paper on "Stresses and Temperature Effects in Dams, with Particular Reference to Aswan Dam"; D. H. B. Reynolds, for his paper on "The Movement of Water in the Middle and Lower Chalk of the River Dour Catchment"; F. R. Melville and R. le Geyt Hetherington, jointly for their paper on "The Pegu Yomas Scheme for the Water-Supply of Rangoon"; B. J. Thorpe, for his paper on "High-Altitude Test Plant: New Ancillary Services for Testing Engines, Carburettors, and Aircraft Components under High-Altitude Conditions".

Coopers Hill War Memorial Prize: Prof. A. L. L. Baker, for his paper on "The Heysham Jetty".

Webb Prize: C. E. Dunton and K. Brinsmead, jointly for their paper on "Design, Installation and Maintenance of Long Welded Rails".

Indian Premium: C. G. Sexton, for his paper on "Pre-stressed Reinforced-Concrete Hangar at the Civil Airport of Karachi".

James Prescott Joule Medal and *Miller Prize:* S. Rodin, for his paper on "Site Exploration".

James Forrest Medal and a *Miller Prize:* D. M. Beaton, for his paper on "Coast Protection and Land Reclamation in Holland".

Miller Prizes: S. B. Hart, for his paper on "The Clifton Suspension Bridge"; T. K. George and K. Balasubrahmanyam, jointly for their paper on "The Rational Design of Settlement Tanks"; J. R. Smith, for his paper on "Surveying for Tunnels"; A. R. Goode, for his paper on "Gas Turbines as a Means of Propulsion"; J. D. Harris, for his paper on "Pre-stressed Concrete"; E. Lightfoot, for his paper on "The Open Frame Girder and its Analysis"; R. Franklin, for his paper on "Notes on Surveying from Air Photographs".

Institution Medal and Premium of £10: P. G. Bedson, for his paper on "The Design of Buttress Dams".

Charles Hawksley Prize: J. Black, for his design of a railway station, and a special prize of £50 to J. R. Stanley, for his design of a water tower.

Bayliss Prize: W. E. A. Skinner.

Special thanks of the Institution are accorded to H. J. B. Manzoni, for his paper on "Winter Conditions and the Civil Engineer: Municipal Engineering"; and to W. K. Wallace, for his paper on "Winter Conditions and the Civil Engineer: Railways", who as members of Council were not eligible for awards.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Monday, November 29

UNIVERSITY OF LONDON (at the Institute of Education, Malet Street, London, W.C.1), at 5.30 p.m.—Prof. E. D. Edwards: "Education for International Understanding—China".*

ENGINEERS STUDY GROUP ON ECONOMICS (at the Central Hall, Westminster, London, S.W.1), at 7 p.m.—Sir John Boyd Orr, F.R.S.: "An Approach to World Government".

ROYAL INSTITUTE OF CHEMISTRY (joint meeting with the WOOLWICH POLYTECHNIC CHEMICAL SOCIETY, at Woolwich Polytechnic, Woolwich, London, S.E.18), at 7.30 p.m.—Mr. M. S. C. Birbeck: "The Electron Microscope".

Tuesday, November 30

UNIVERSITY COLLEGE, LONDON (in the Anatomy Theatre, Gower Street, London, W.C.1), at 1.15 p.m.—Prof. H. E. M. Barlow: "Modern Electric Lighting Technique", I.*
(Second Lecture will be given on Thursday, December 2.)

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Anniversary Meeting.

SIR HALLEY STEWART TRUST LECTURE (at the Memorial Hall, Farringdon Street, London, E.C.4), at 6 p.m.—Mr. Lionel Curtis: "The Atomic Age—The Political Repercussions".*

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS, PHYSICAL METHODS GROUP (in the Chemistry Lecture Theatre, Imperial College of Science and Technology, Imperial Institute Road, London, S.W.7), at 6 p.m.—Annual General Meeting; Mr. R. Donaldson: "The Measurement of Colour".

ASSOCIATION OF BRITISH SCIENCE WRITERS (at Shell Film Theatre, Shell-Mex House, Strand, London, W.C.2), at 7 p.m.—Lecture on "The Scientific Film".

INSTITUTION OF THE RUBBER INDUSTRY (at Caxton Hall, Caxton Street, London, S.W.1), at 7 p.m.—Mr. T. R. Dawson: "Lignin".

Wednesday, December 1

UNIVERSITY OF LONDON (in the Physiology Theatre, University College, Gower Street, London, W.C.1), at 5.15 p.m.—Dr. J. W. Trevan: "Statistics from the Standpoint of a Pharmacologist".*
(Further lecture on December 8.)

INSTITUTION OF ELECTRICAL ENGINEERS, RADIO SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. P. R. Coursey: "Fixed Resistors for use in Communication Equipment, with special reference to 'High Stability' Resistors".

LINNEAN SOCIETY OF LONDON (in conjunction with the SYSTEMATICS ASSOCIATION, at Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Demonstration: "Taxonomy up to and including Linnæus".

MANCHESTER METALLURGICAL SOCIETY (at the Engineers' Club, Albert Square, Manchester), at 6.30 p.m.—Mr. F. Fancutt and Mr. J. C. Hudson: "The Protection of Iron and Steel against Corrosion".

INSTITUTE OF WELDING, MANCHESTER AND DISTRICT BRANCH (in the Reynolds Hall, College of Technology, Manchester), at 7 p.m.—Mr. C. Schofield: "Fabrication of Resistance Welding".

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (joint meeting with the FOOD GROUP of the SOCIETY OF CHEMICAL INDUSTRY, at the Institution of Civil Engineers, Great George Street, London, S.W.1), at 7 p.m.—Discussion on "Food Standards and Labelling".

SOCIETY OF CHEMICAL INDUSTRY, PLASTICS GROUP (joint meeting with the NORTHERN IRELAND SECTION, at the Royal Belfast Academic Institution, Belfast), at 7.30 p.m.—Dr. R. G. R. Bacon: "Some Chemical Aspects of Plastics Manufacture".

Thursday, December 2

CHADWICK PUBLIC LECTURE (at St. Mary's Hospital Medical School, Norfolk Place, Praed Street, London, W.2), at 4.30 p.m.—Dr. C. Seeley: "Preventive Medicine and Clinical Medicine in relation to the Public Health" (Malcolm Morris Memorial Lecture).*

CHEMICAL SOCIETY, LIVERPOOL SECTION (joint meeting with the LOCAL SECTIONS of the BRITISH ASSOCIATION OF CHEMISTS, the ROYAL INSTITUTE OF CHEMISTRY and the SOCIETY OF CHEMICAL INDUSTRY, at the University, Liverpool), at 4.30 p.m.—Sir John Lennard-Jones, F.R.S.: "Modern Theories of Chemical Valency".

INSTITUTION OF MINING AND METALLURGY (at Film House, Wardour Street, London, W.1), at 5 p.m.—Film on "Atomic Physics".

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. A. G. Milnes: "Magnetic Amplifiers"; Mr. H. M. Gale and Mr. P. D. Atkinson: "The Theory and Design of Magnetic Amplifiers".

UNIVERSITY OF LONDON (in the Chemistry Theatre, University College, Gower Street, London, W.C.1), at 5.30 p.m.—Prof. E. D. Hughes: "The Kinetics and Mechanism of Reactions" (Inaugural Lecture).*

CHEMICAL SOCIETY, SHEFFIELD SECTION (joint meeting with the LOCAL SECTION of the ROYAL INSTITUTE OF CHEMISTRY and the SHEFFIELD UNIVERSITY CHEMICAL SOCIETY, in the Chemistry Department Lecture Theatre, the University, Sheffield), at 6 p.m.—Sir Wallace Akers: "Problems in the Production of Useful Power from Nuclear Energy".

ROYAL AERONAUTICAL SOCIETY (at the Institution of Civil Engineers, Great George Street, London, S.W.1), at 6 p.m.—Mr. G. R. Edwards: "Problems in the Development of a New Aeroplane".

LEEDS METALLURGICAL SOCIETY (in the Chemistry Department, The University, Leeds), at 7 p.m.—Dr. J. Ward: "Recent Developments in Photoelasticity".

ROYAL INSTITUTE OF CHEMISTRY (at Acton Technical College, High Street, Acton, London, W.3), at 7.30 p.m.—Dr. N. Booth: "Careers for Chemists".

SOCIETY OF CHEMICAL INDUSTRY, CHEMICAL ENGINEERING GROUP (joint meeting with the BRISTOL SECTION of the SOCIETY OF CHEMICAL INDUSTRY, in the Chemistry Department, the University, Bristol), at 7 p.m.—Dr. Katherine Williams: "The Physiological Effects of the Products of Nuclear Fission".

Friday, December 3

CHEMICAL SOCIETY, GLASGOW SECTION (in the Royal Technical College, Glasgow), at 2.15 p.m.—Scientific Papers.

UNIVERSITY OF LONDON (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 5.15 p.m.—Dr. H. R. Ing: "The Pharmacology of Homologous Series".*

GEOLOGISTS' ASSOCIATION (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 6 p.m.—Prof. H. H. Read, F.R.S.: "International Geological Congress, London, 1948".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 9 p.m.—Prof. F. E. Zeuner: "Time in Evolution".

Saturday, December 4

BIOCHEMICAL SOCIETY (at the Middlesex Hospital Medical School, London, W.1), at 11 a.m.—Scientific Papers.

LONDON COUNTY COUNCIL (at the Horniman Museum, London Road, Forest Hill, London, S.E.23), at 2.30 p.m.—Dr. Reginald Le May: "The Ancient Monuments of Cambodia, including Angkor".*

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN PHYSICS—The Principal, Acton Technical College, High Street, Acton, London, W.3 (December 4).

LECTURER IN TEXTILES at Coventry Technical College—The Director of Education, Council House, Coventry (December 4).

ASSISTANT LECTURER IN PHARMACEUTICAL CHEMISTRY at Bradford Technical College—The Director of Education, Town Hall, Bradford (December 4).

EDITOR—The General Secretary, Chemical Society, Burlington House, Piccadilly, London, W.1 (December 4).

VICE-PRINCIPAL (Ref. G.479/48A) and ASSISTANT LECTURERS (2, Ref. G.480/48A) for the West Sussex County Agricultural Executive Committee's Agricultural Training Centre at Brinsbury, Pulborough—The Ministry of Labour and National Service, Technical and Scientific Register (K.), York House, Kingsway, London, W.C.2, quoting the appropriate Ref. No. (December 4).

ASSISTANT LECTURER IN GEOGRAPHY—The Secretary, London School of Economics, Houghton Street, Aldwych, London, W.C.2 (December 6).

SENIOR LECTURER IN AGRICULTURE (with special qualifications in Crop Husbandry and with teaching experience)—The Registrar, The University, Leeds 2 (December 6).

JUNIOR ASSISTANT PHYSICIST IN THE CLINICAL PHYSICS DEPARTMENT—The Secretary and House Governor, Mount Vernon Hospital and the Radium Institute, Northwood, Middx. (December 8).

STATISTICIANS in various Government Departments—The Secretary, Civil Service Commission, 6 Burlington Gardens, London, W.1, quoting No. 2316 (December 11).

CANDIDATE with a research degree and qualification in chemical engineering (Ref. TT/107), and a CANDIDATE with chemical engineering qualifications and considerable research experience (Ref. TT/106), for two appointments in the Central Research Establishment of the National Coal Board at Stoke Orchard, Cheltenham—The National Coal Board, Establishments (General) Branch, Hobart House, Grosvenor Place, London, S.W.1, quoting the appropriate Ref. No. (December 13).

DEPUTY DIRECTOR AND SENIOR LECTURER IN THE DEPARTMENT OF CHEMICAL PATHOLOGY—The House Governor, St. Mary's Hospital and Medical School, Paddington, London, W.2 (December 13).

DEPARTMENTAL DEMONSTRATOR IN GEOLOGY AND PETROLOGY—The Professor of Geology, University Museum, Oxford (December 14).

SENIOR RESEARCH OFFICER (Ref. No. 1987), a TECHNICAL SECRETARY (Ref. No. 1988), and five RESEARCH OFFICERS (Ref. No. 1989), on the staff of the Coal Survey Section of the Council for Scientific and Industrial Research, Sydney—The Chief Scientific Liaison Officer, Australian Scientific Research Liaison Office, Africa House, Kingsway, London, W.C.2, quoting appropriate Ref. No. (December 18).

LECTURER IN BIOCHEMISTRY, a DEMONSTRATOR IN BIOCHEMISTRY, and a DEMONSTRATOR IN GENERAL PHYSIOLOGY—The Registrar, University College of South Wales, Cathays Park, Cardiff (December 18).

PROFESSOR OF PHYSICS, and a LECTURER IN BACTERIOLOGY, in the University of Queensland—The Secretary, Association of Universities of the British Commonwealth, 32 Woburn Square, London, W.C.1 (December 31).

SENIOR LECTURER or LECTURER IN MATHEMATICS, and a SENIOR LECTURER or LECTURER IN PHYSICAL CHEMISTRY, in the University College of the West Indies—The Secretary, Inter-University Council for Higher Education in the Colonies, 8 Park Street, London, W.1 (February 15).

MYCOLOGIST as *Oidium* Research Officer to the Rubber Research Scheme, Ceylon—The Secretary, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, South Kensington, London, S.W.7 (February 28).

LECTURERS (2) IN THE DEPARTMENT OF PHYSICS, Sunderland Technical College—The Director of Education, Education Offices, 15 John Street, Sunderland.

CHEMIST (Scientific Officer grade) for fundamental research on physical chemistry of metal systems at higher temperatures, and a RESEARCH ASSISTANT for work on physical chemistry of metal systems in which radioactive tracer techniques are employed—The Personnel Officer, British Iron and Steel Research Association, 11 Park Lane, London, W.1.

LECTURER IN THE DEPARTMENT OF CHEMISTRY AND BIOLOGY—The Registrar, Municipal College, Portsmouth.

RESEARCH TECHNICIAN IN THE DENTAL SCHOOL—Prof. Matthews, The University, Manchester 13.

PHYSICAL CHEMISTS (Senior Scientific Officer and Scientific Officer grades), an ORGANIC CHEMIST (Scientific Officer grade), CHEMISTS (Experimental Officer grade), a CHEMICAL ENGINEER (Scientific Officer grade), and ENGINEERS (Experimental Officer grade), in a Ministry of Supply research and development establishment in Lancashire—The Ministry of Labour and National Service, Technical and Scientific Register (K.), York House, Kingsway, London, W.C.2, quoting F.936/48A.

EDITORIAL ASSISTANT for the *Journal* of the Institution—The Secretary, Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2.

HONOURS GRADUATE IN PHYSICS OR ELECTRICAL ENGINEERING, to assist in the further development of a 2 million volt electrostatic generator and to co-operate in radiobiological research using the neutrons and X-rays from this machine—The Director, Radiotherapeutic Research Unit, Hammersmith Hospital, Ducane Road, London, W.12.

EDUCATIONAL PSYCHOLOGIST—The Chief Education Officer, Education Office, Warrior Square, Southend-on-Sea.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Nuffield College. The Problem facing British Universities. Pp. 131. (London: Oxford University Press, 1948.) 5*s.* net. [48

British Journal of Herpetology. No. 1, June 1948. Pp. 38. (London: British Herpetological Society, c/o British Museum (Natural History), 1948.) 4*s.* [58

Reports on the Progress of Applied Chemistry. Vol. 32, 1947. Pp. 518. (London: Society of Chemical Industry, 1948.) [58

XVIII International Geological Congress. Symposium on the Geology, Paragenesis and Reserves of the Ores of Lead and Zinc. Edited by K. C. Dunham. Pp. 230. (London: Geological Survey and Museum, 1948.) 15*s.* [98